Armed Forces College of Medicine

AFCM

Neuroscience Module/ Prof Azza Kamal

Functional Areas of Cerebral Hemispheres

BY
Prof Azza Kamal

Intended Learning Outcomes

By the end of this lecture , the student will be able to:

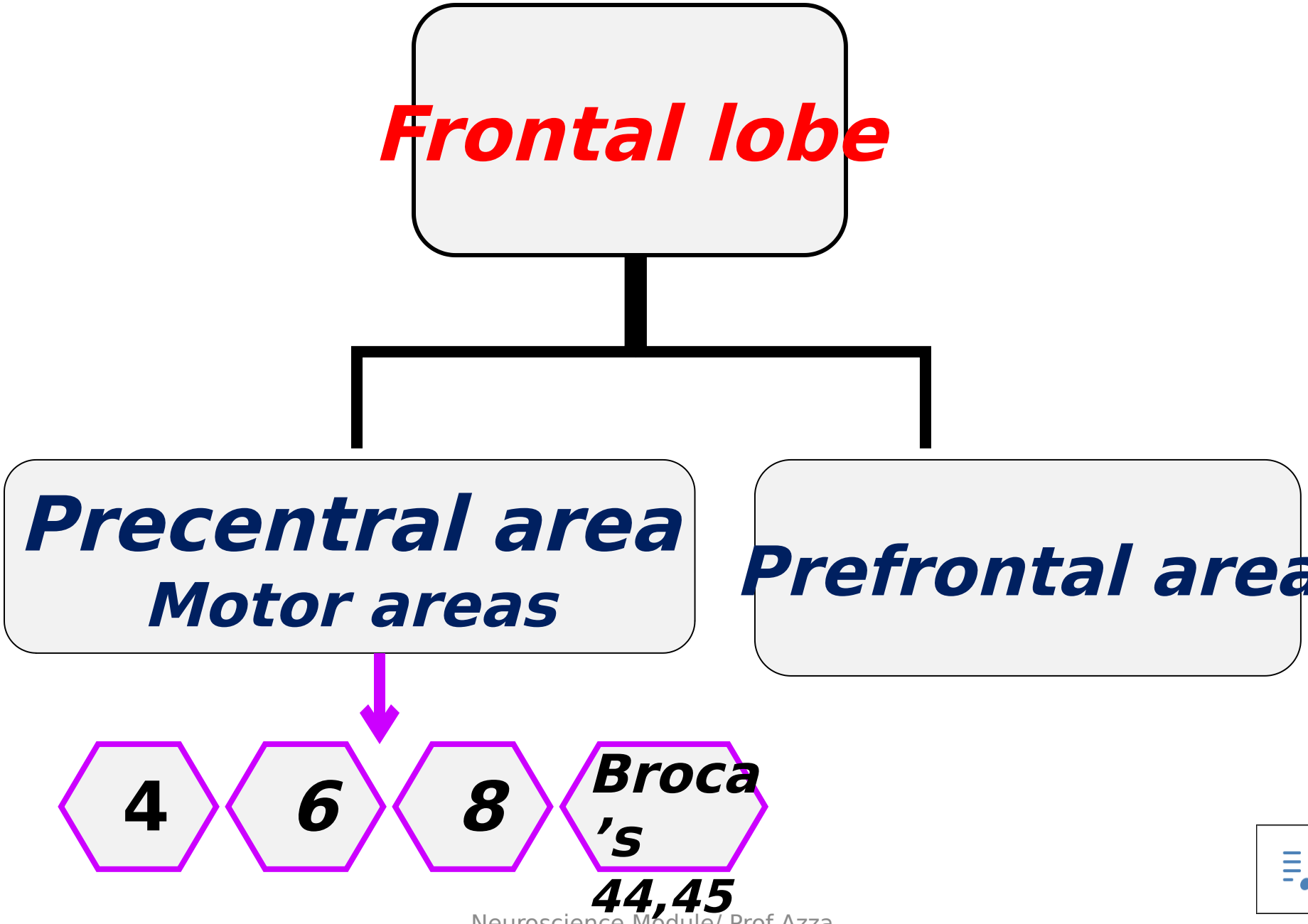
1. Locate the main functional areas of the cerebral hemispheres.
2. Predict effect of lesion in any of these areas.
3. Define cerebral asymmetry & cerebral dominance.

KEY POINTS OF LECTURE

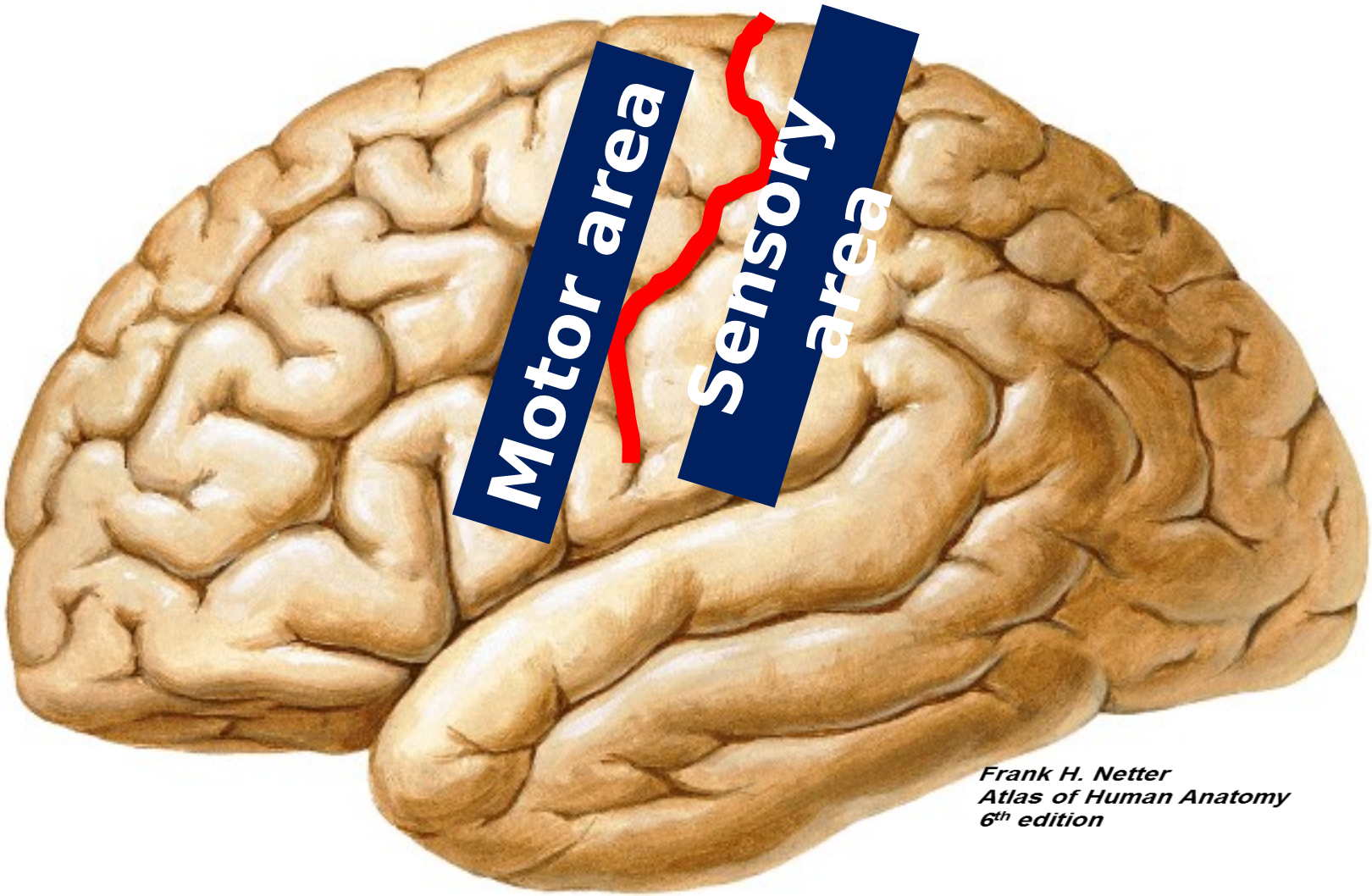
1) Functional areas of **FRONTAL** lobe and the effects of lesion
2) Functional areas of **PARIETAL** lobe and the effects of lesion
3) Functional areas of **TEMPORAL** lobe and the effects of lesion
4) Functional areas of **OCCIPITAL** lobe and the effects of lesion

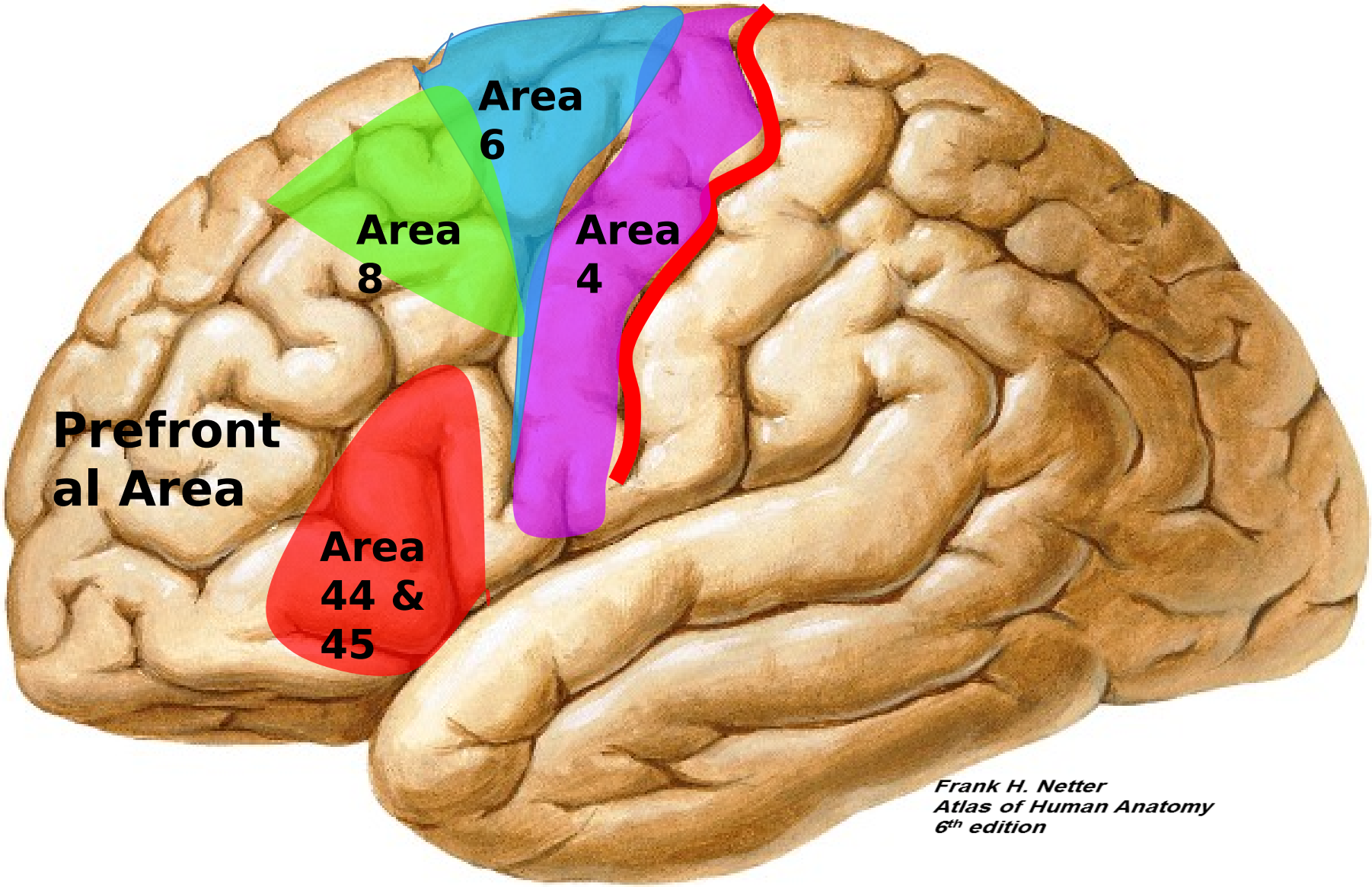
Functional Areas

The Frontal Lobe


Frontal lobe
Precentral area
Motor areas
Prefrontal area
4
6
8
Broca's
44,45

Central sulcus




Area 6
Area 8
Area 4
Prefrontal Area
Area 44 & 45
Frank H. Netter
Atlas of Human Anatomy
6th edition

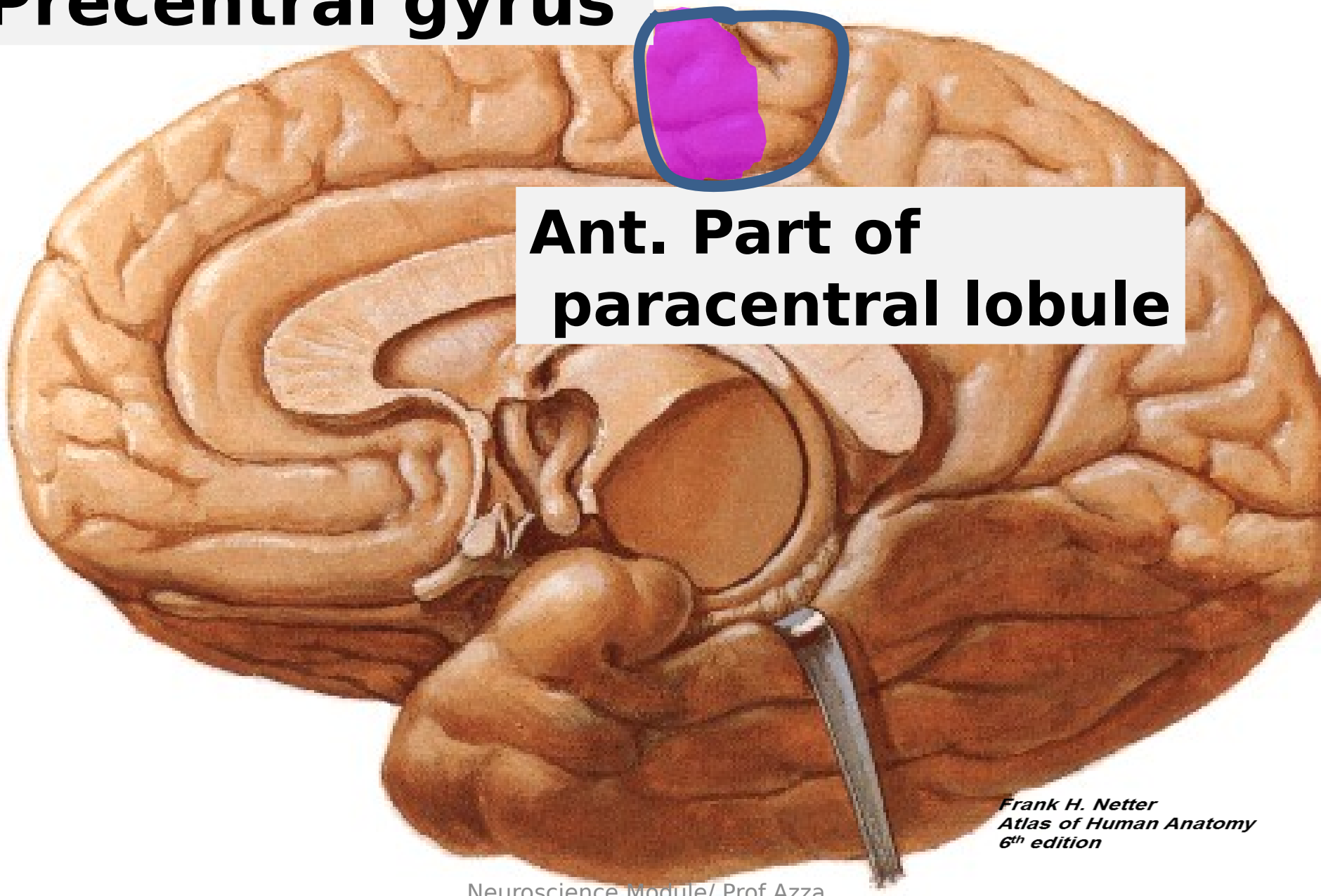
Area 4
Primary motor area

site ***representatic*** ***function*** ***lesion***

Area 4 (Primary motor area) :

- **Site:** Precentral gyrus & ant. part of paracentral lobule.
- **Body representation:** it contains a map of contralateral ½ of body represented upside down (motor homunculus) so face is lower down & leg and foot in paracentral lobule.
- **Representation is proportionate to skill;** so parts with fine skilled movements e.g. hands occupy larger areas.
- **Function:** initiates discrete voluntary

Precentral gyrus



Ant. Part of paracentral lobule

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Representation

ntralateral half of body

Up side down

(face lower down

while leg & foot are

n paracentral lobule)

ea of represntation

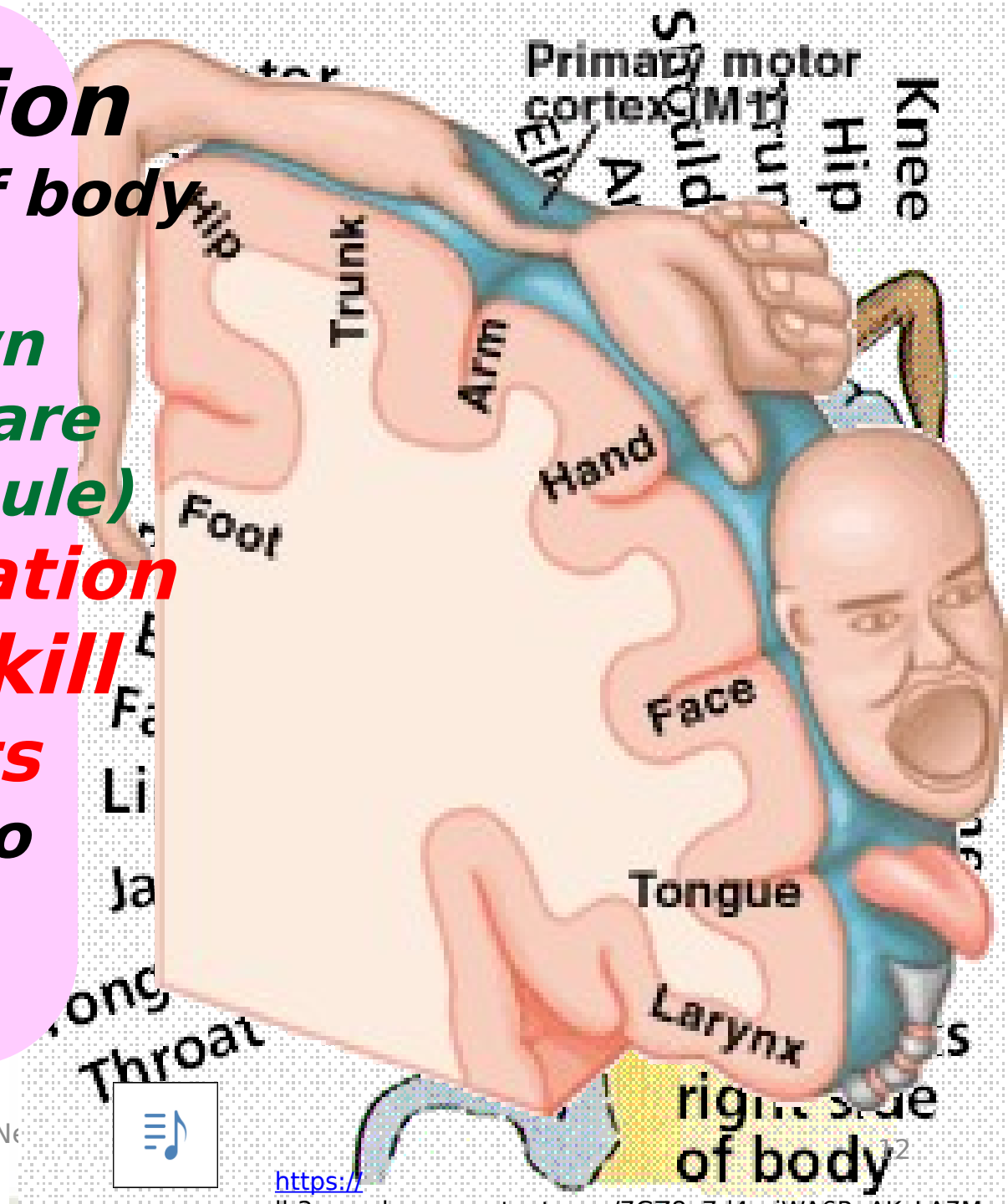
s according to skill

of movements

not according to

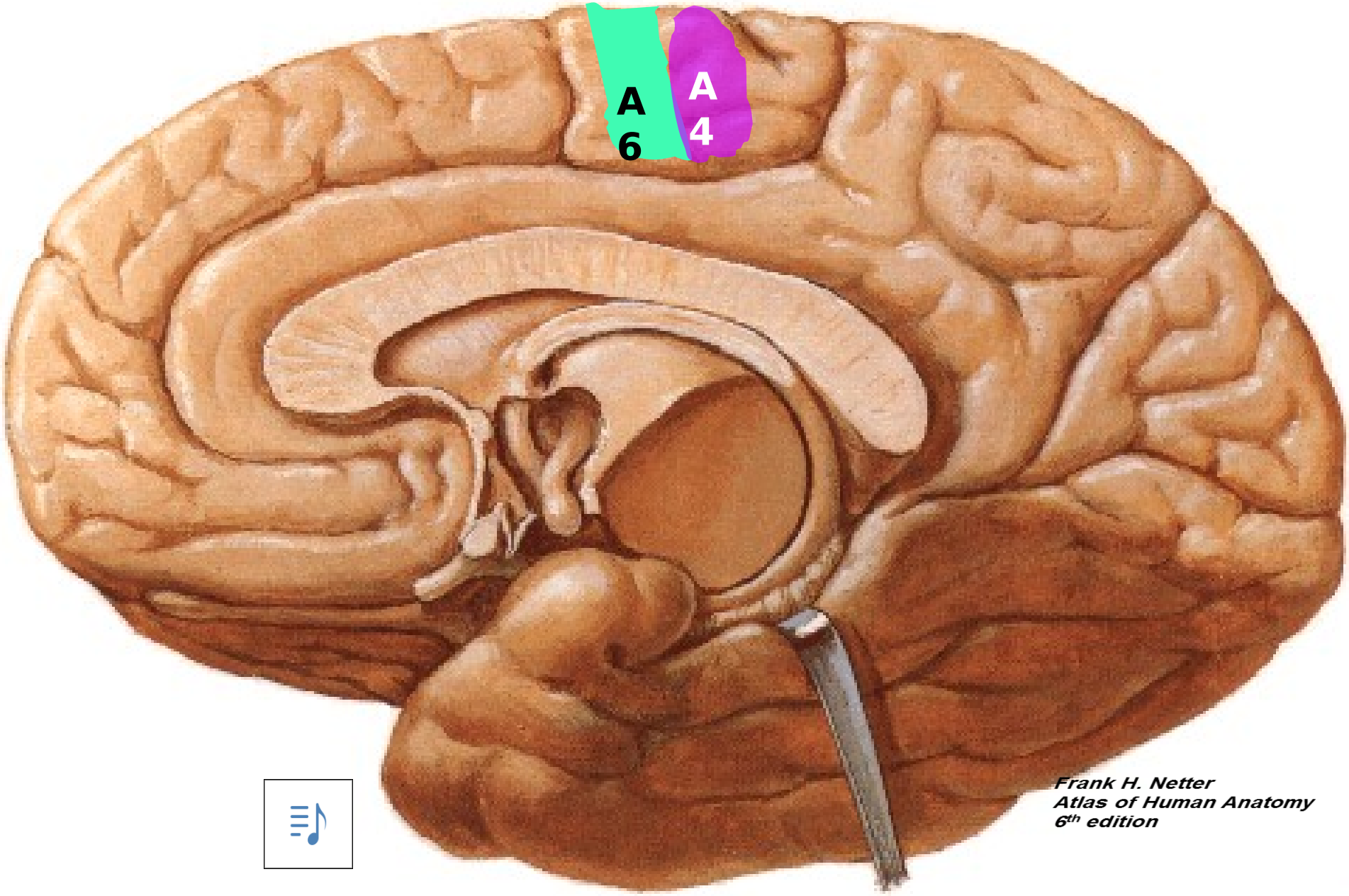
size of

body part



Premotor Area 6

- **Site** ⇒ **infront of area 4 in sup., middle & inf. frontal gyri + extends on med. surface**
- **Functions** ⇒ **plans the movement & stores the plan. It adjusts the posture to start the movement. It inhibits muscle tone & grasp reflex.**
- **Lesion** ⇒ **awkwardness of movements “apraxia” , spasticity of muscles & reappearance of grasp reflex**


A
6
A
4
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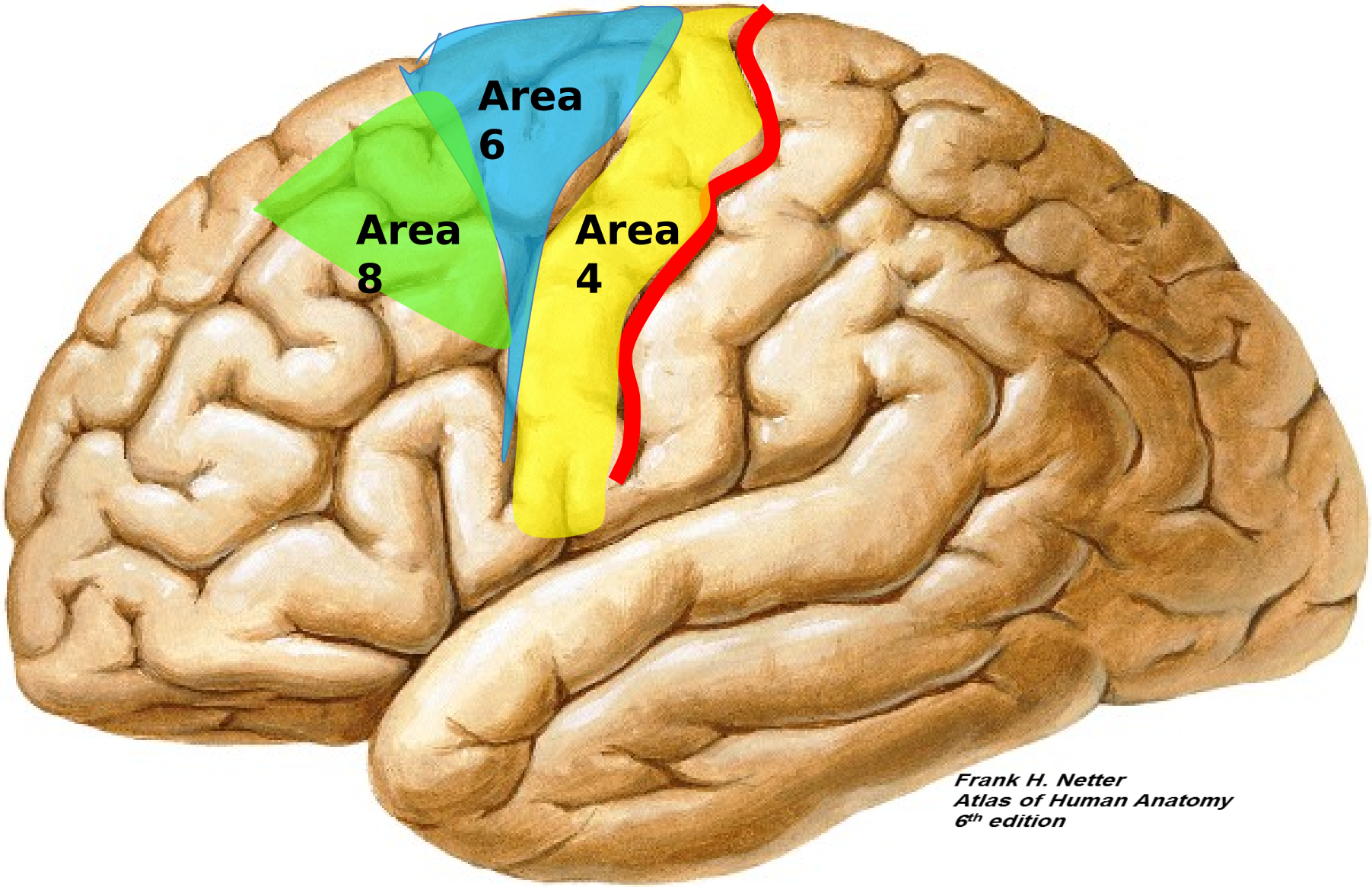
ea 8 (frontal eye fiel

- **Site** **infront of area 6 in sup. & middle frontal gyri**
- **Function** **voluntary conjugate eye movements. Its stimulation leads to contralateral deviation of both eyes.**
- **Lesion** **1) ipsilateral deviation of both eyes towards side of the lesion**
  2) inability to turn eyes to opposite side

Reflex conjugate eye movements not affected since it is controlled by occipital eye field


Area 6
Area 8
Area 4
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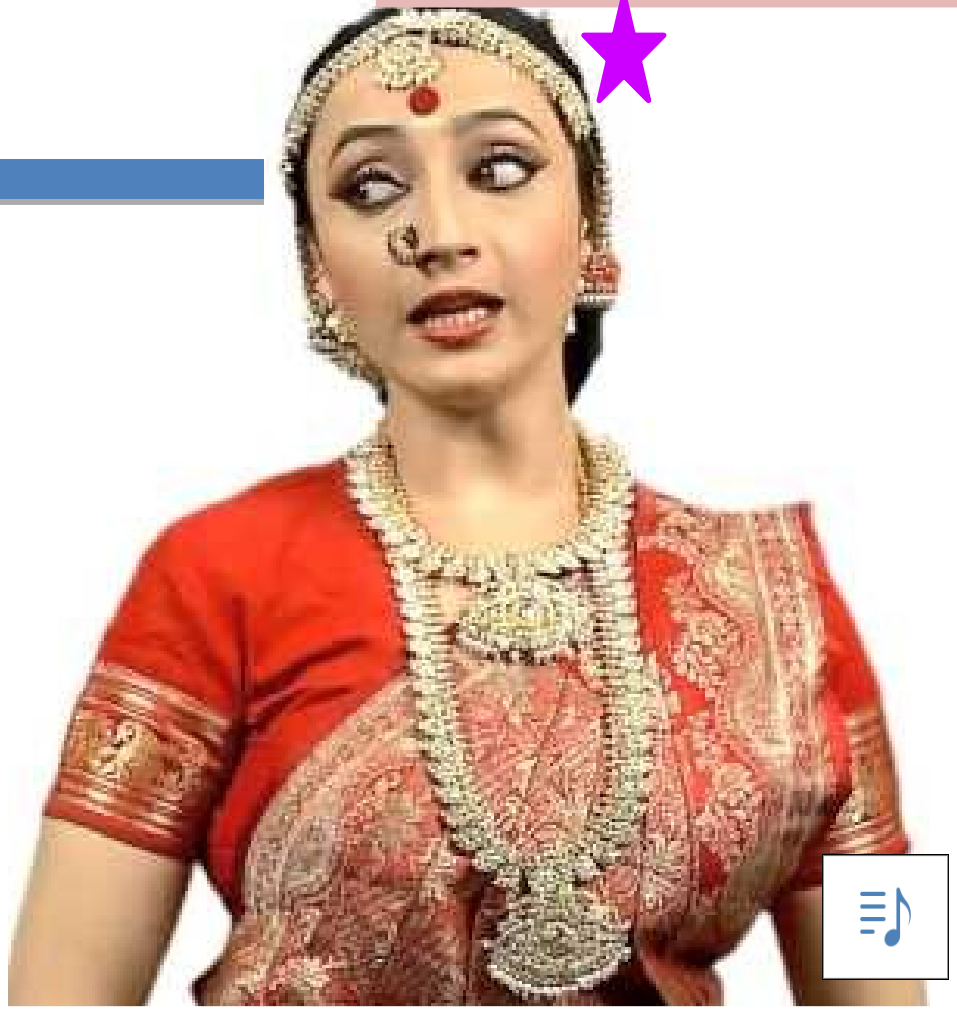
Eyes deviate to the right

Function

ontal eye field A8

Responsible for
luntary conjugate
Eye movement
 Contralateral
viation of
th eyes

Stimulation of lef
frontal eye field A



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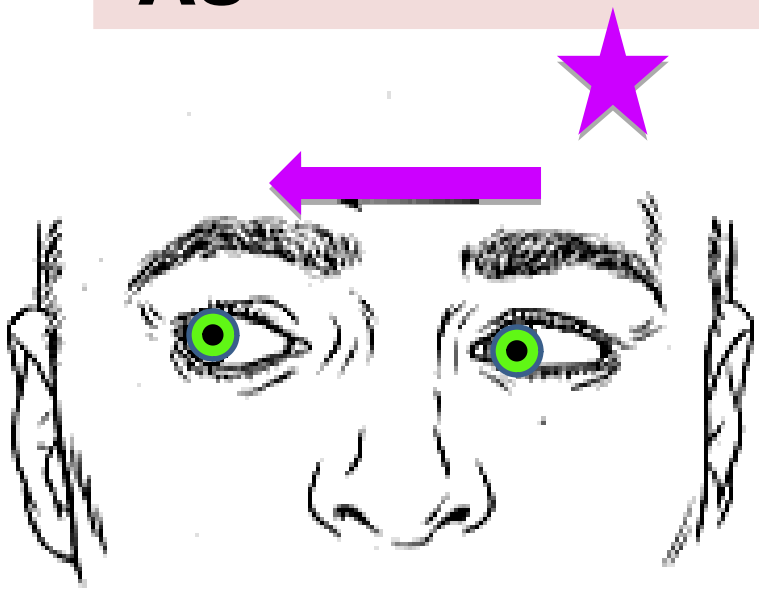
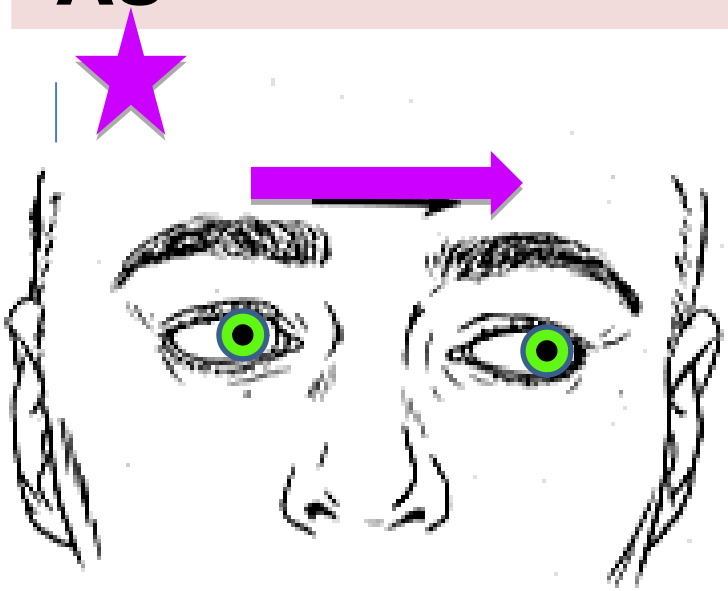
Frontal Eye Field A8



Frontal Eye Field A8



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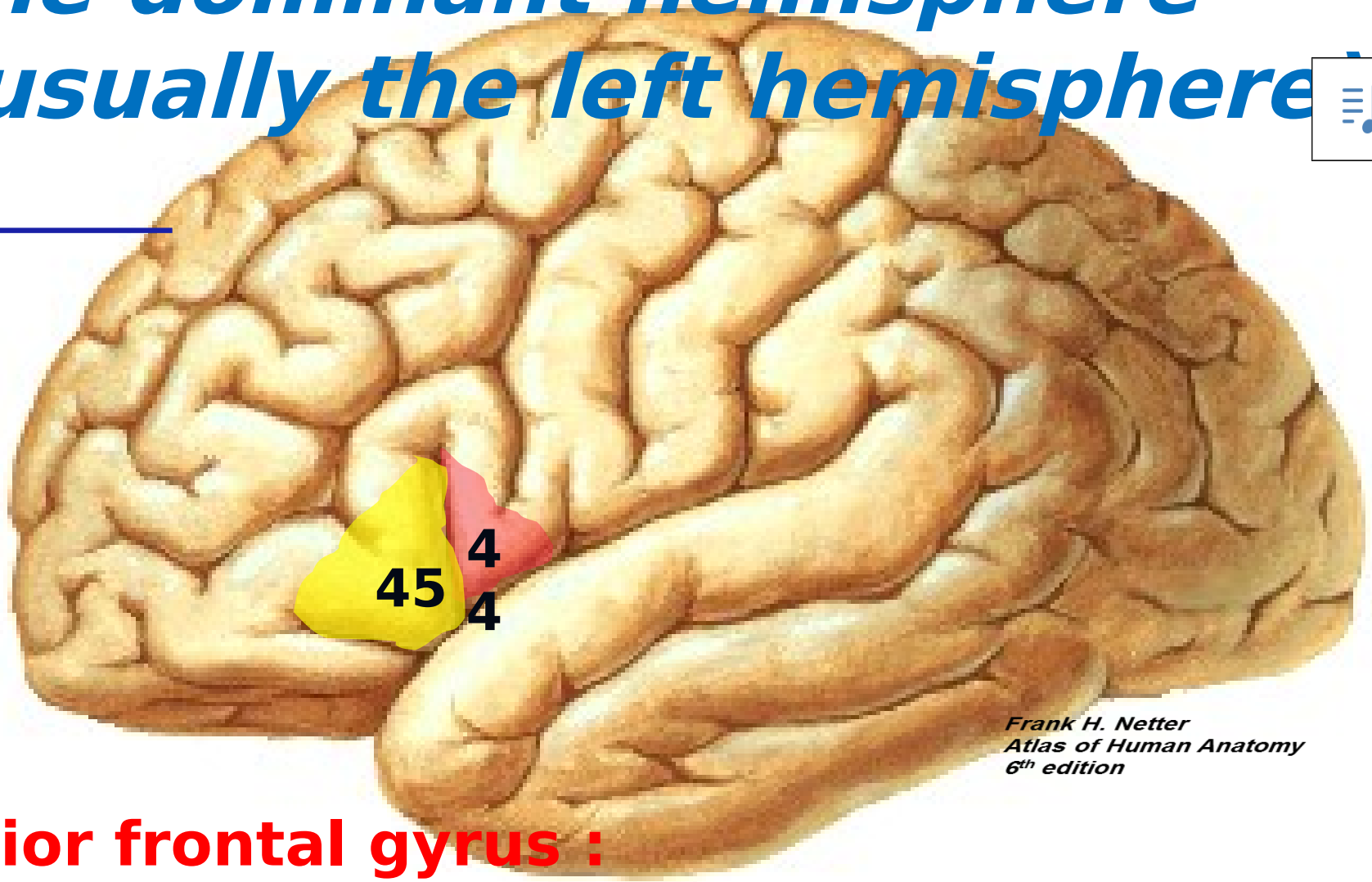
Broca's area is present only in the dominant hemisphere (usually the left hemisphere)



ferior frontal gyrus :

s triangularis (A 45) & pars opercularis (A 44)

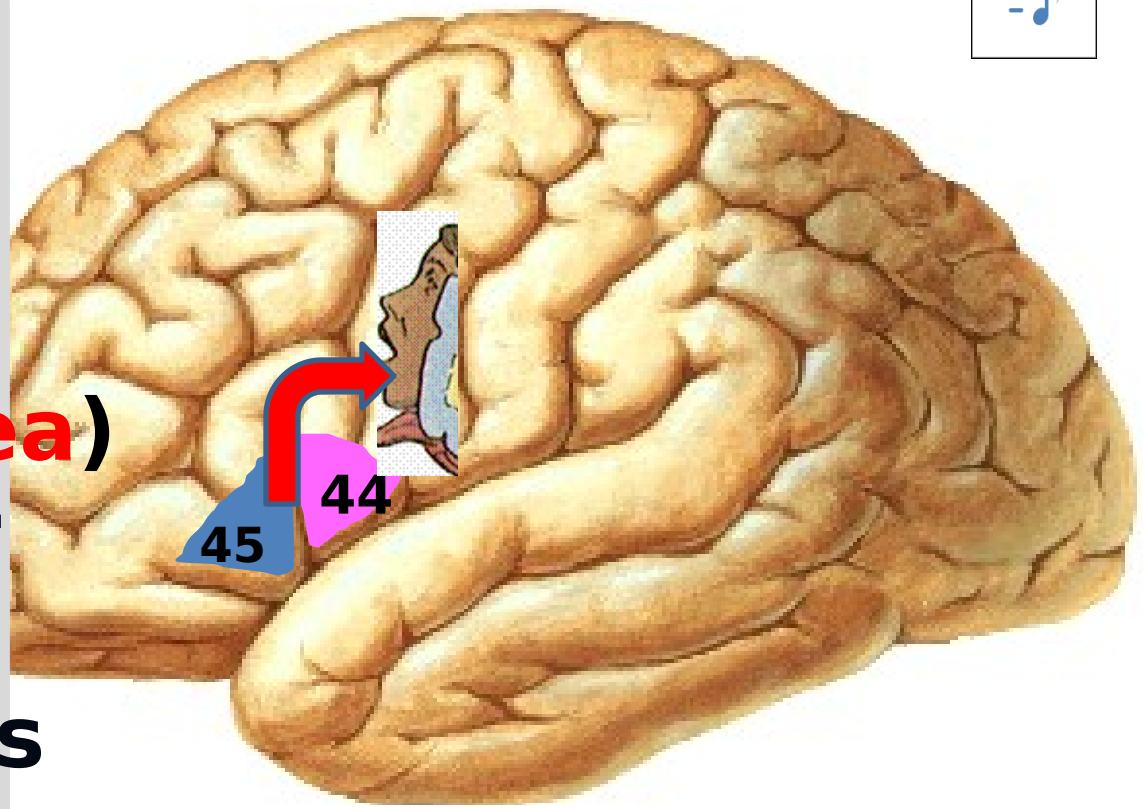
Function

Broca's area

motor speech area)

Responsible for production of intelligible words

(لـغة مـفهومه)

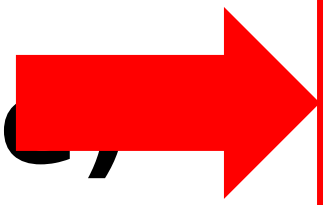


Programs sequence of muscle contrac
to produce intelligible sounds (words)

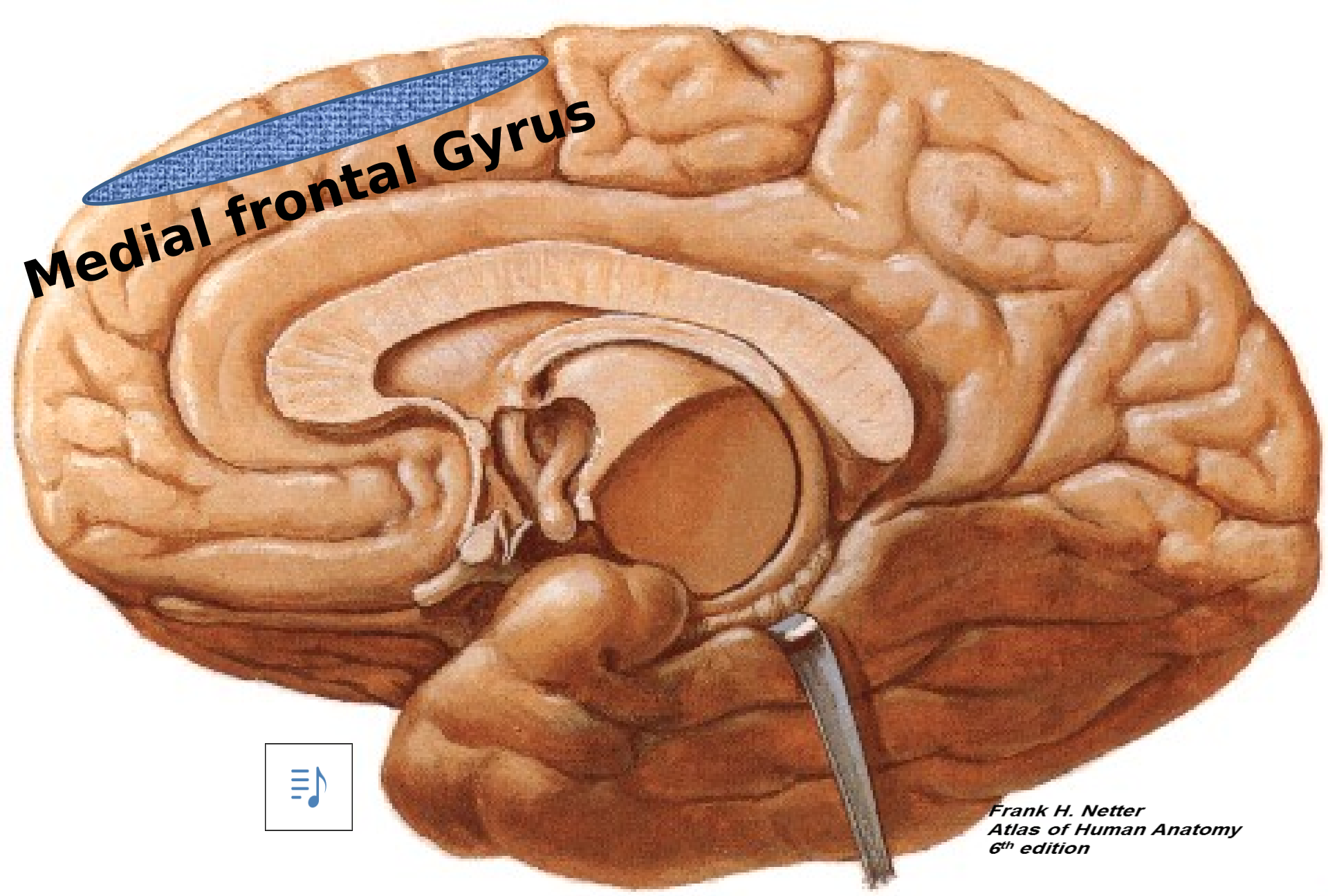
then send these orders to the near
motor area 4

Lesion:

otor (expressive) aphasia



The patient cannot pronounce the words easily, but selects the proper words.


Medial frontal Gyrus
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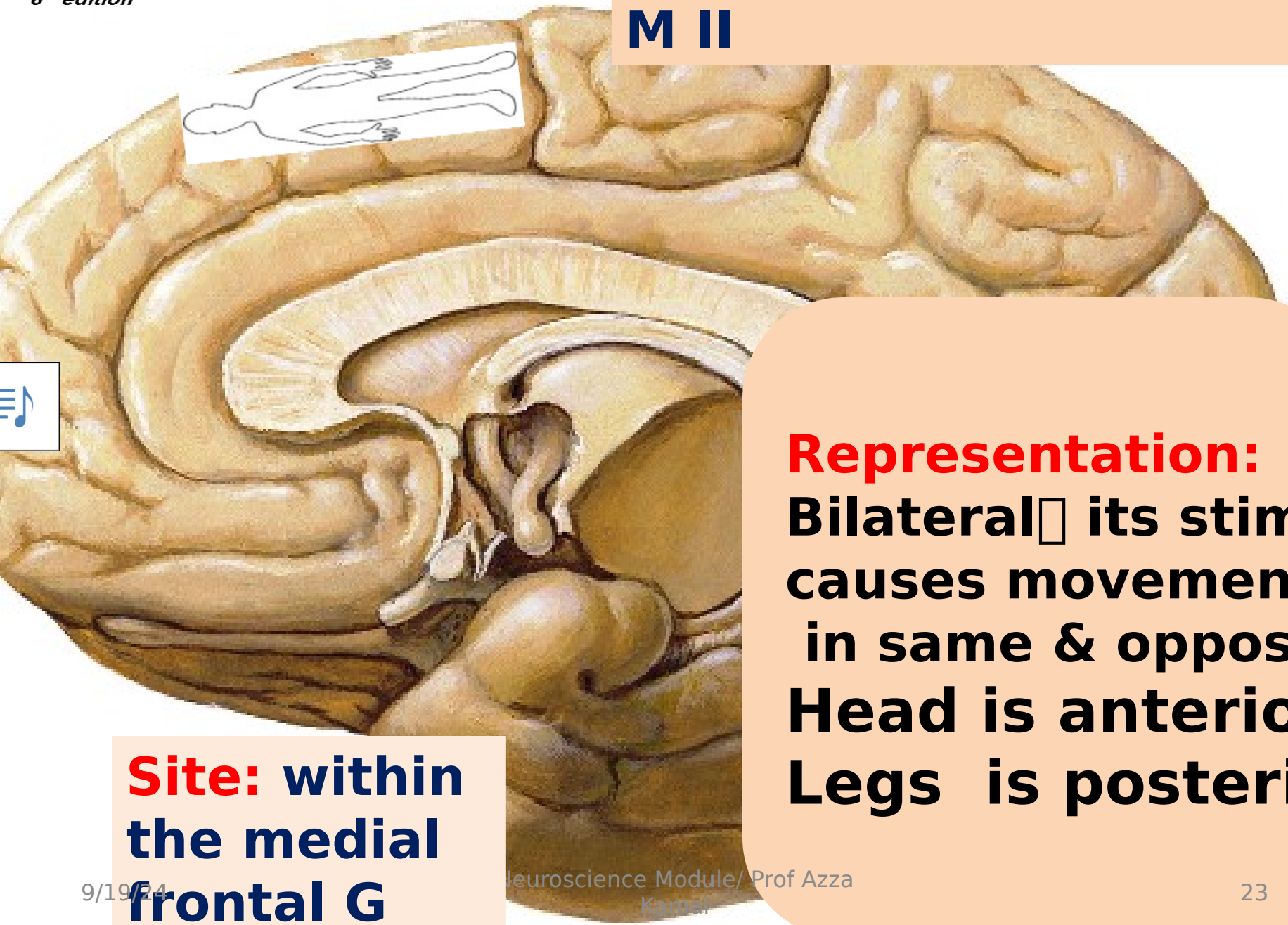
Supplementary motor ar
M II



Representation:

Bilateral its stimul
causes movements
in same & opposite
Head is anterior
Legs is posterio

Site: within the medial frontal G

MII Function

- It plans & stores programmes for difficult or **complex movements** for example movements involving both hands

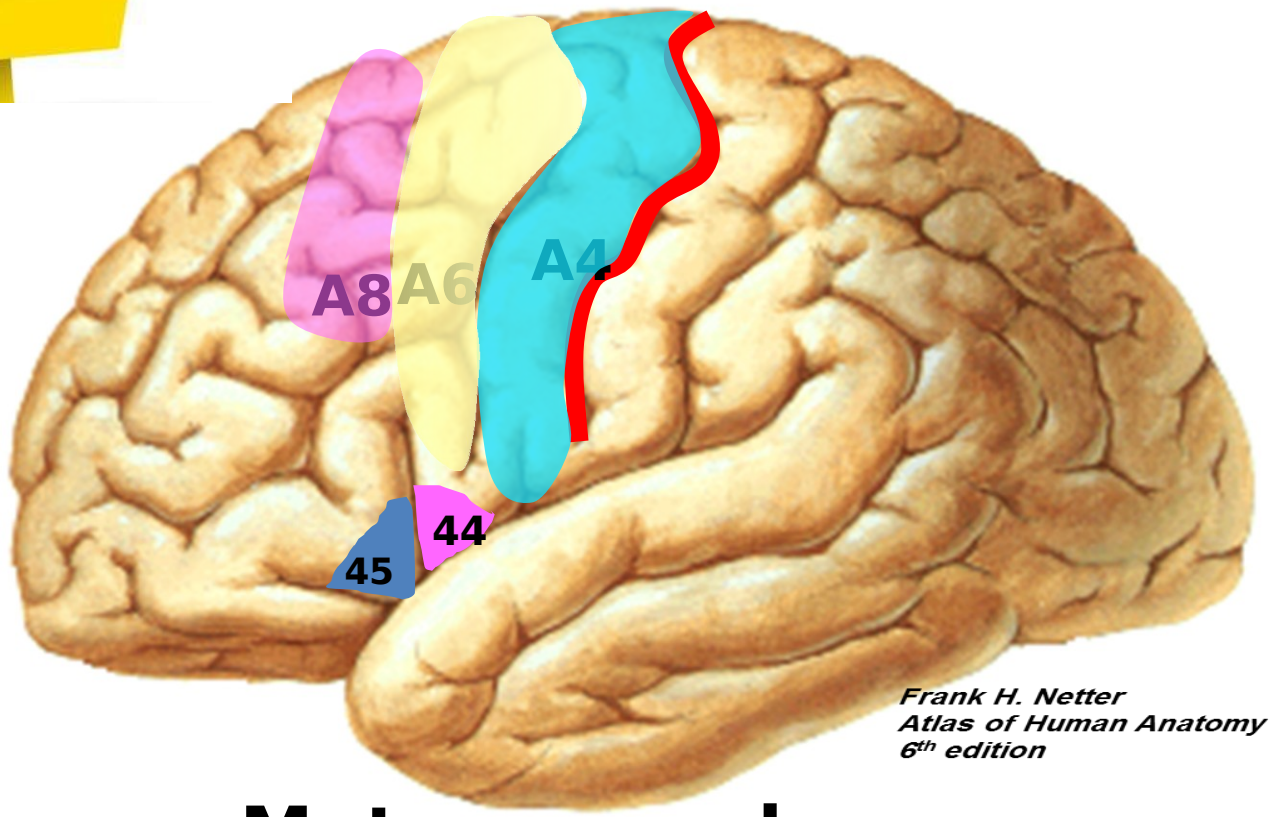
Bimanual movement

- Contains a superior speech center
- **Lesion** temporary : aphasia & inability to move

(Akinetic mutism)

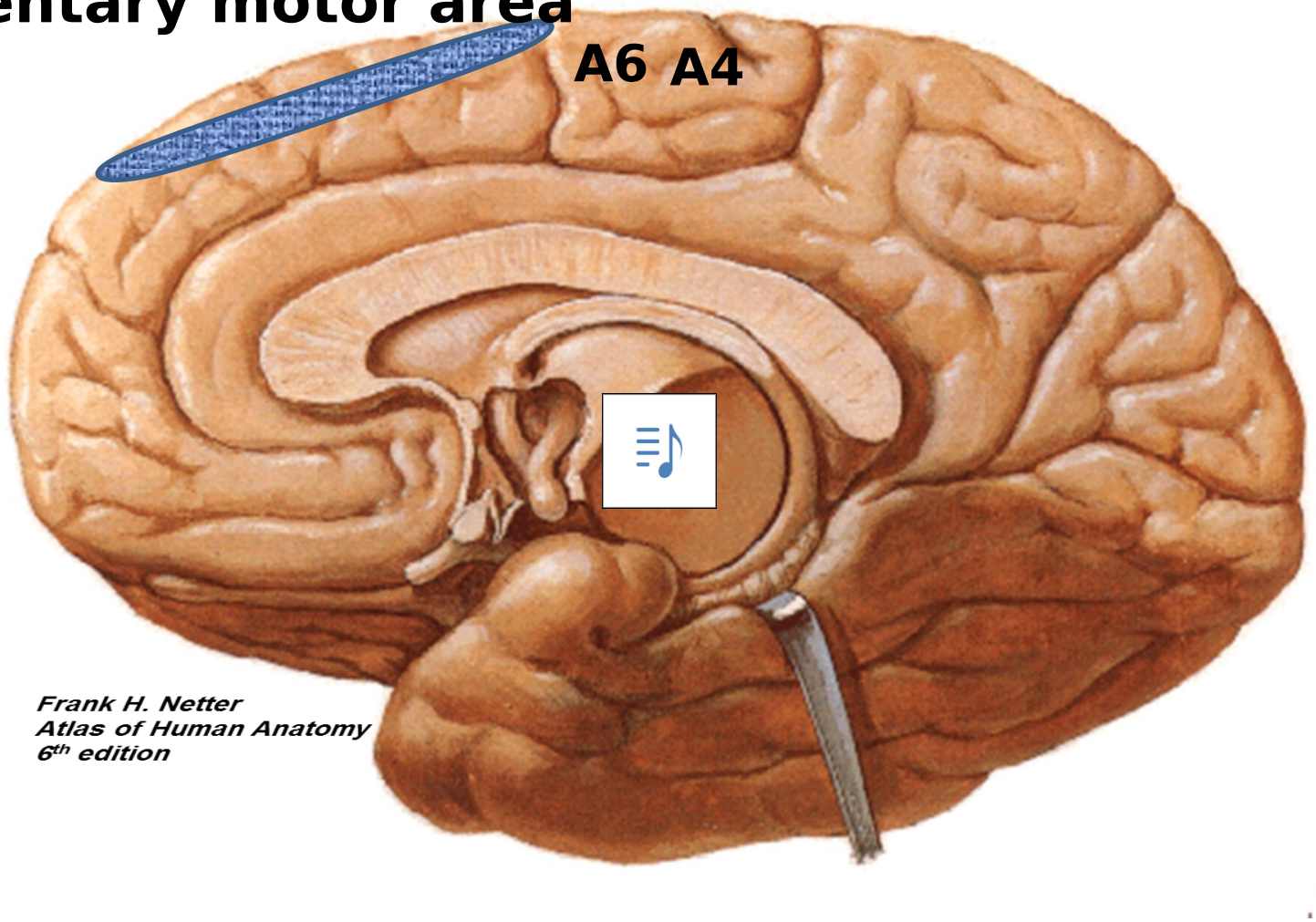
difficulty in performing complex

Precentral area



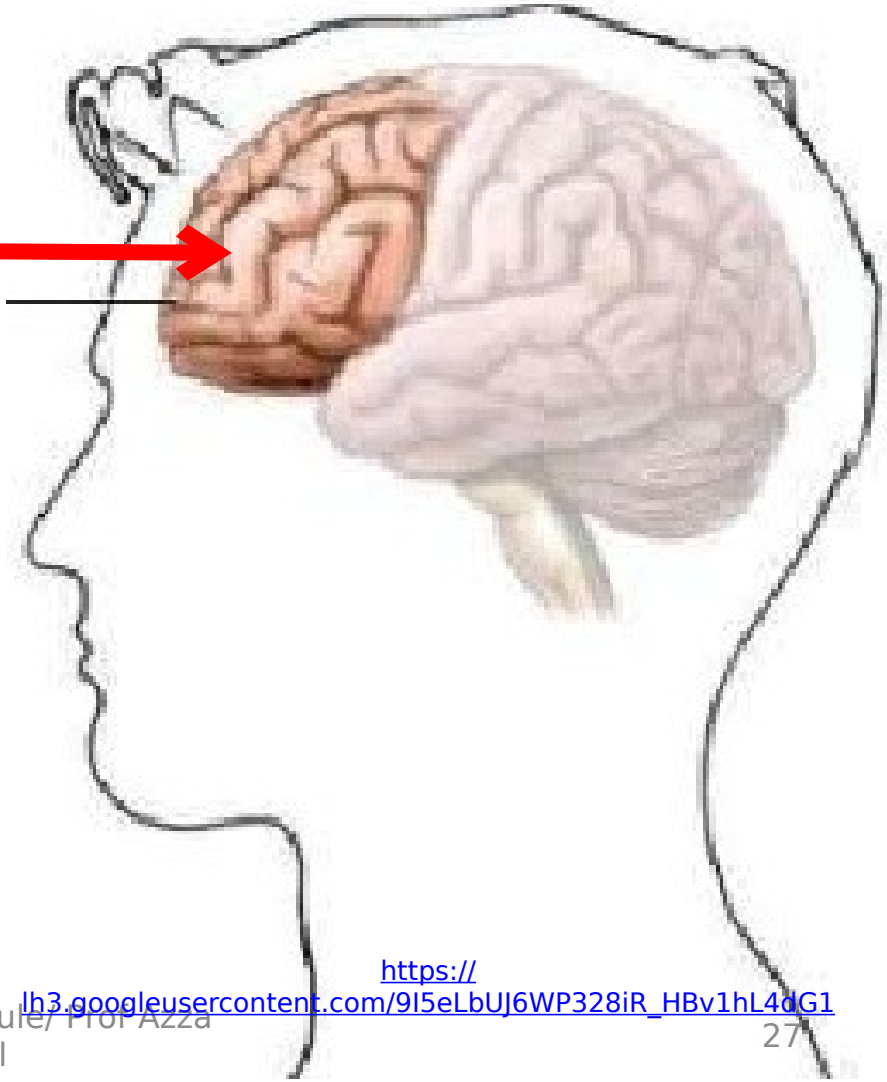
roca's Area = Motor speech area

pplementary motor area



Prefrontal area

Prefrontal area



Site :

1)Remainder of sup., middle & inf. frontal gyri
2)Most of medial frontal gyrus
3)Orbital gyri

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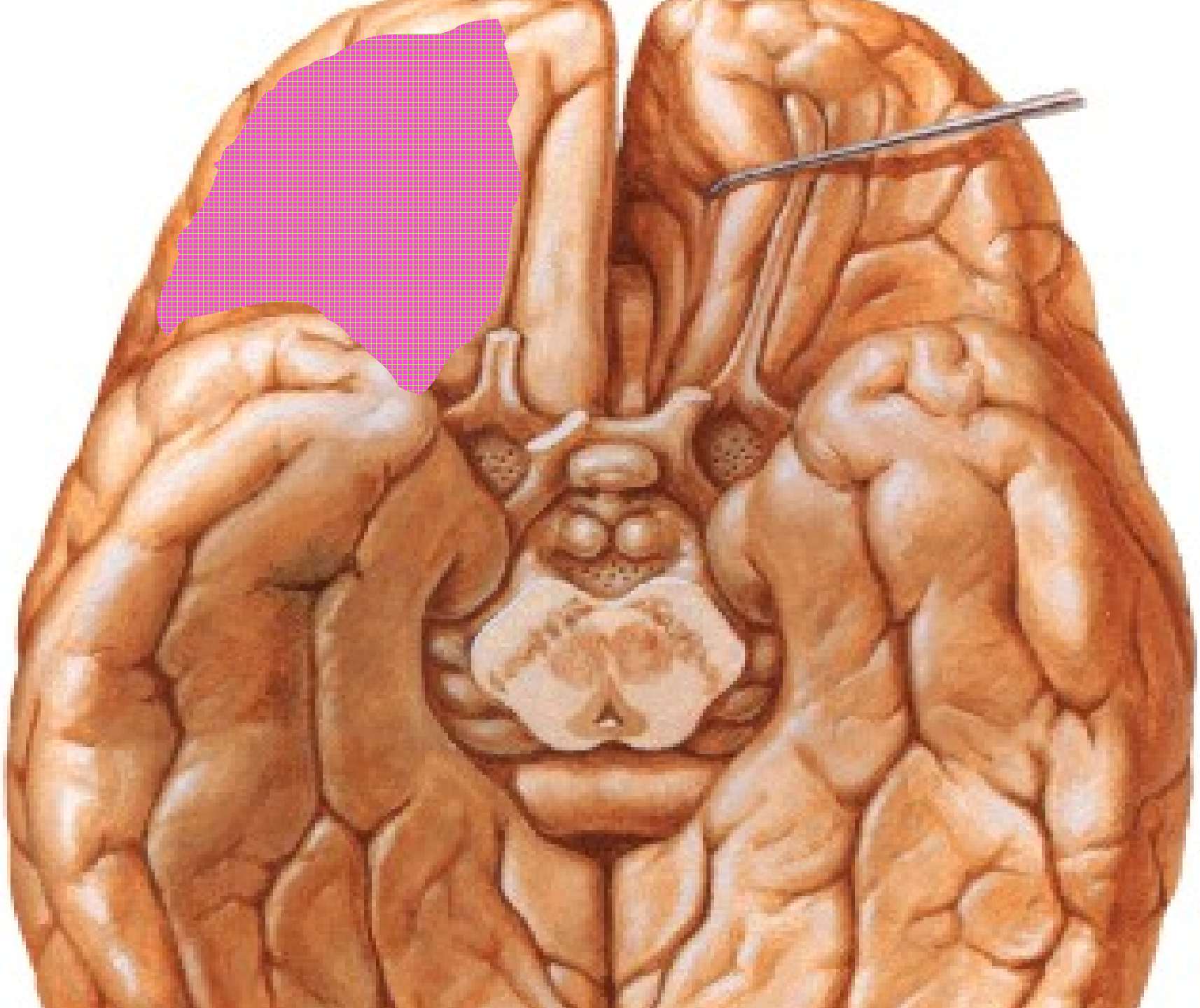

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Function

1) Intelligence
2) Expression of emotion
3) Ability to predict consequences of an action
4) Controls behavior ,mood & personality

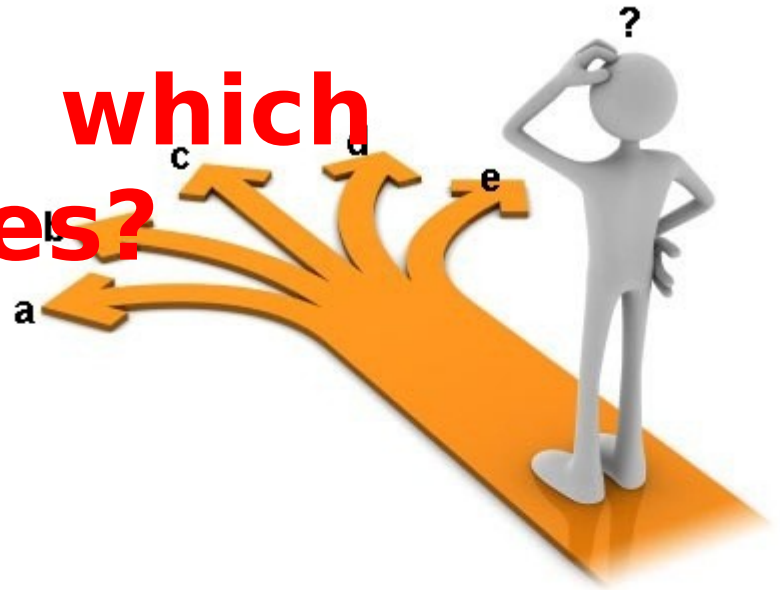
Lesion

Changes in

Behavior, Mo

& Personalit

Broca’s area lies in which of the following sites?



A. Prefrontal area
B. Precentral gyrus
C. Superior frontal gyrus
D. Inferior frontal gyrus
E. Medial frontal gyrus

MCQ to test functional areas in the frontal lobe.

The Parietal Lobe

SI First Somatosensory Area A3,1,2

Site: post. central gyrus + post. part of paracentral

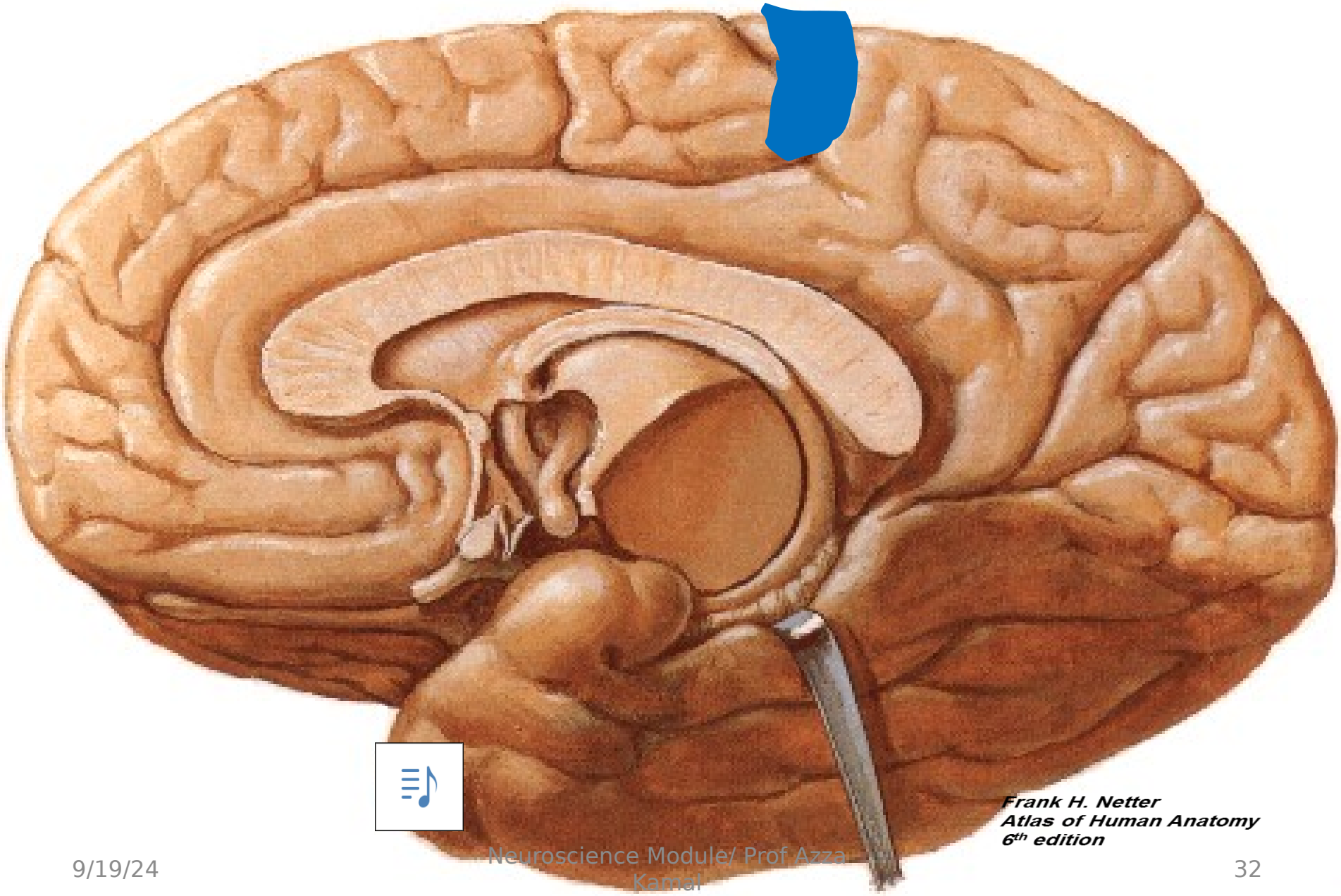
SII Second Somatosensory area

Site: superior lip of post. ramus of lat. sulcus behind central sulcus

Taste area A43

Superior parietal lobule

Inferior parietal lobule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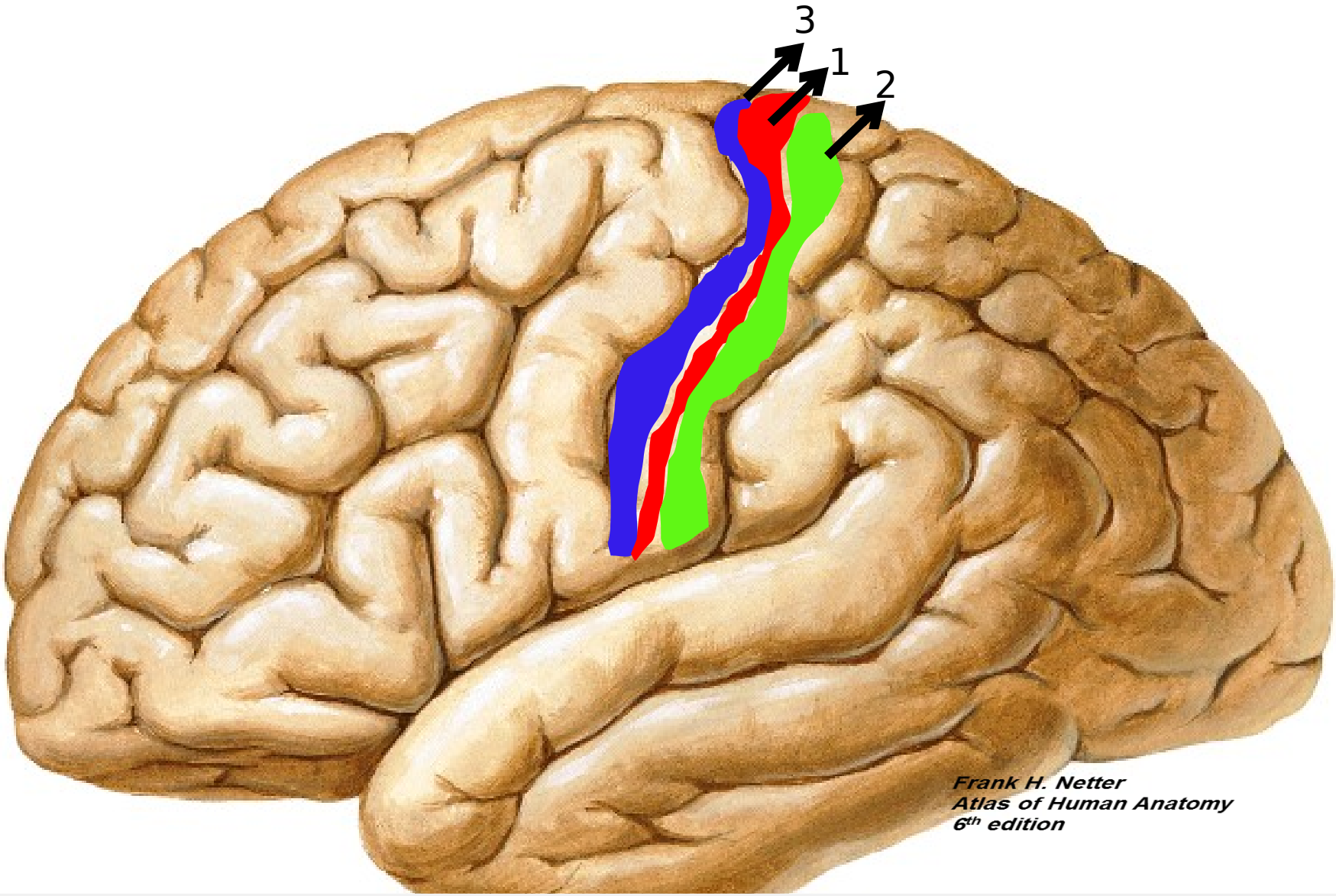


A3 , A1, A2 receive cutaneous & proprioceptive stimuli

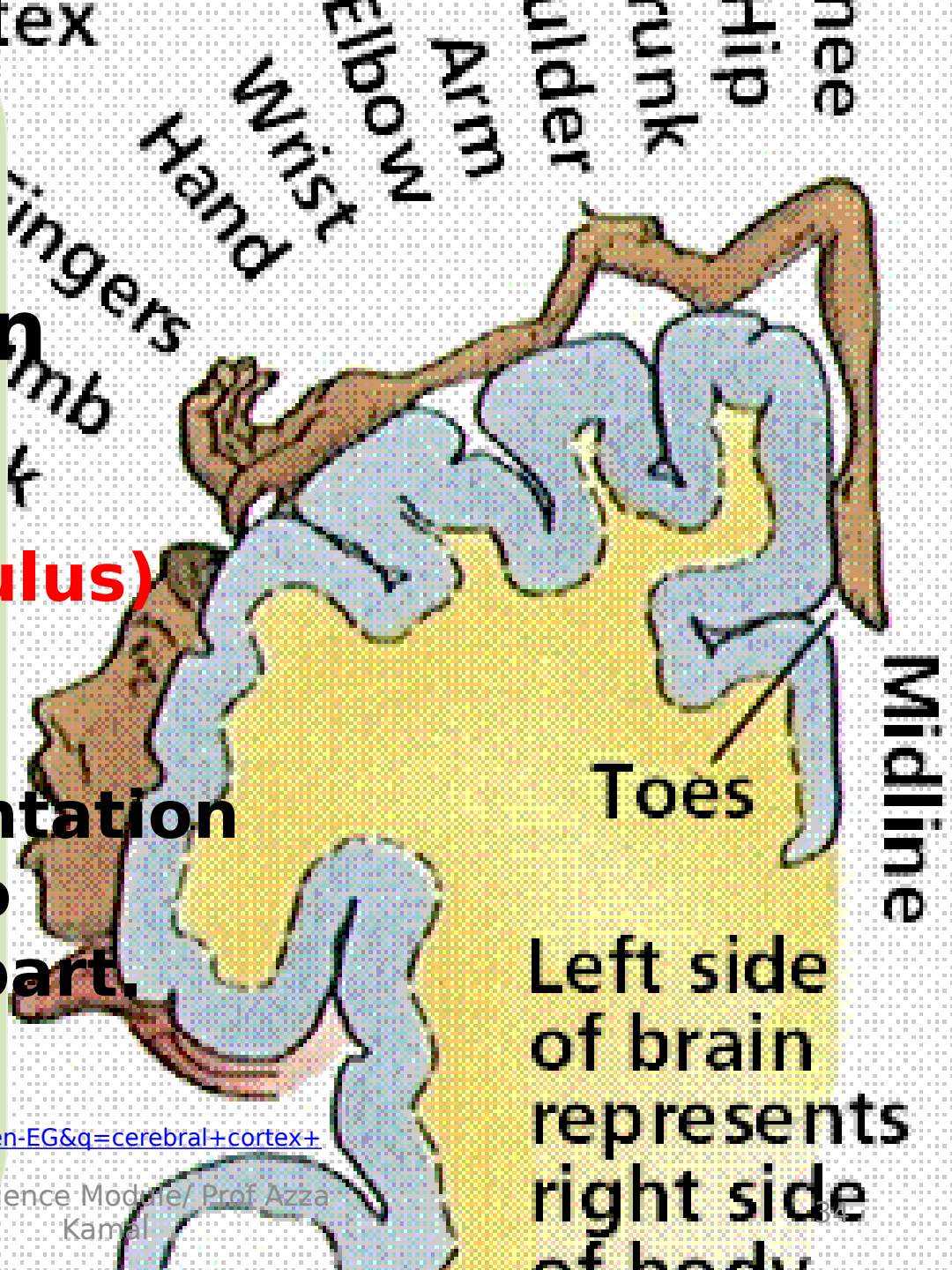
Representation

- Up side down

(sensory homunculus)

- Contralateral

- **Area of representation is proportionate to sensitivity of the part.**



https://www.google.com.eg/search?sa=G&hl=en-EG&q=cerebral+cortex+function

Function

of S_1 area

receives

sensory impulse

from thalamus

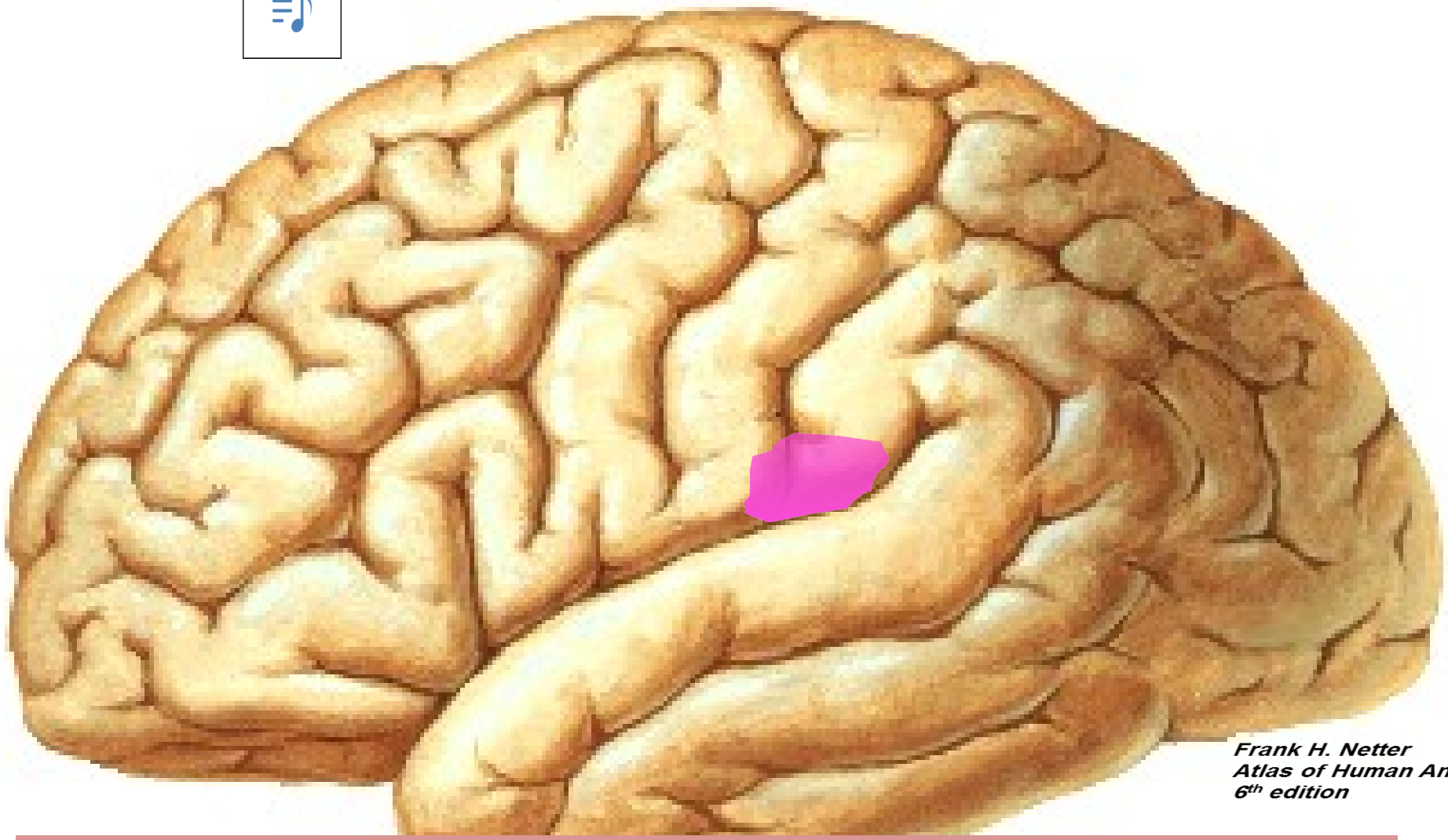
Lesion

Contralateral

Hemianesthesi

(impaired sensation

opposite side of body



Site: superior lip of post. ramus of lat. sulcus , behind the central sulcus

SII

{Second somatosensory Area}

Representation:

Bilateral

Head anterior

Legs posterior

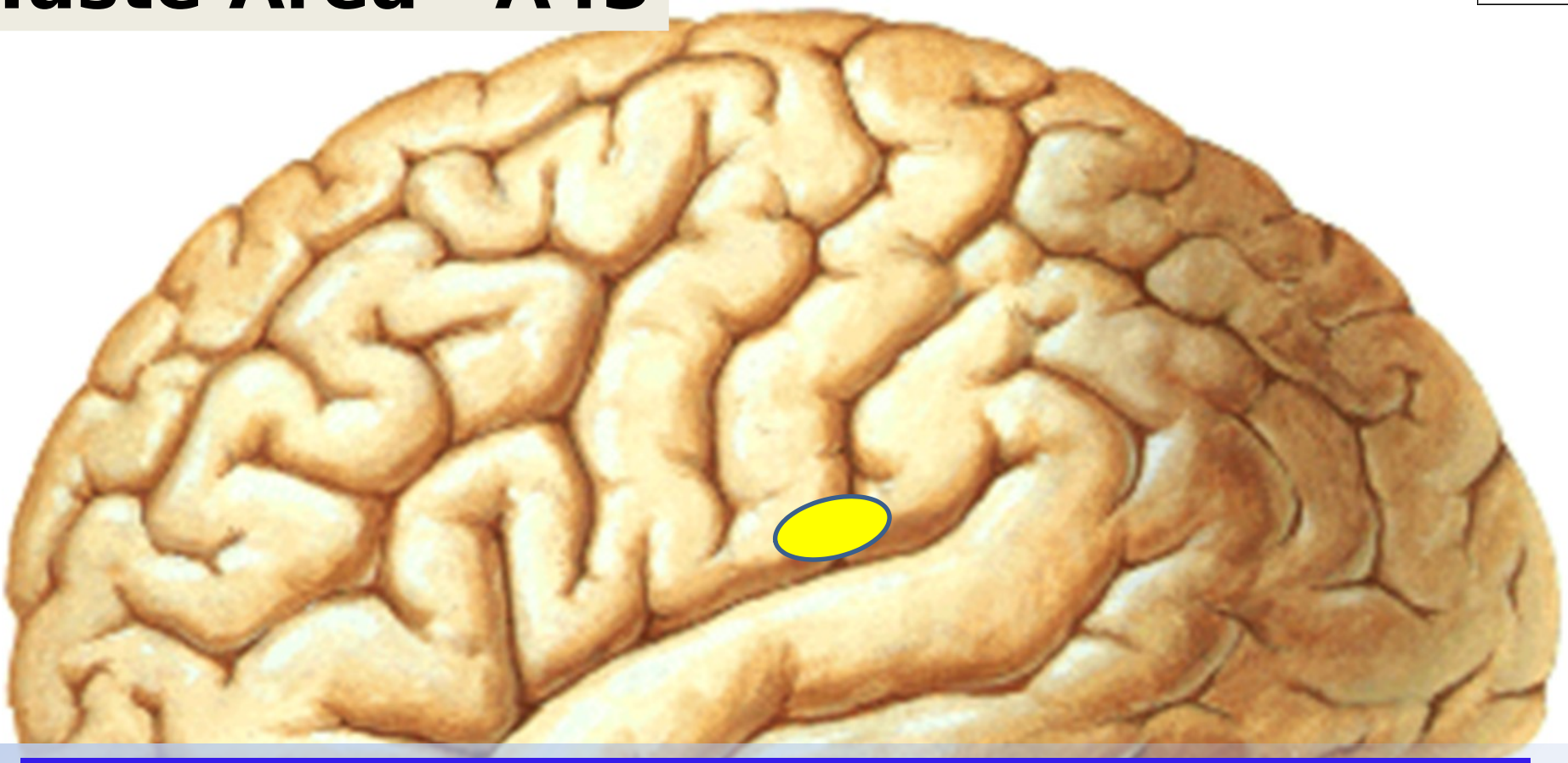
Function:

Perception of transient sensory stimuli (brush stroke)

Lesion:

No recognizable sensory loss

Taste Area A43



Receives ipsilateral solitario-thalamo cortical fibers from VPMN of thalamus

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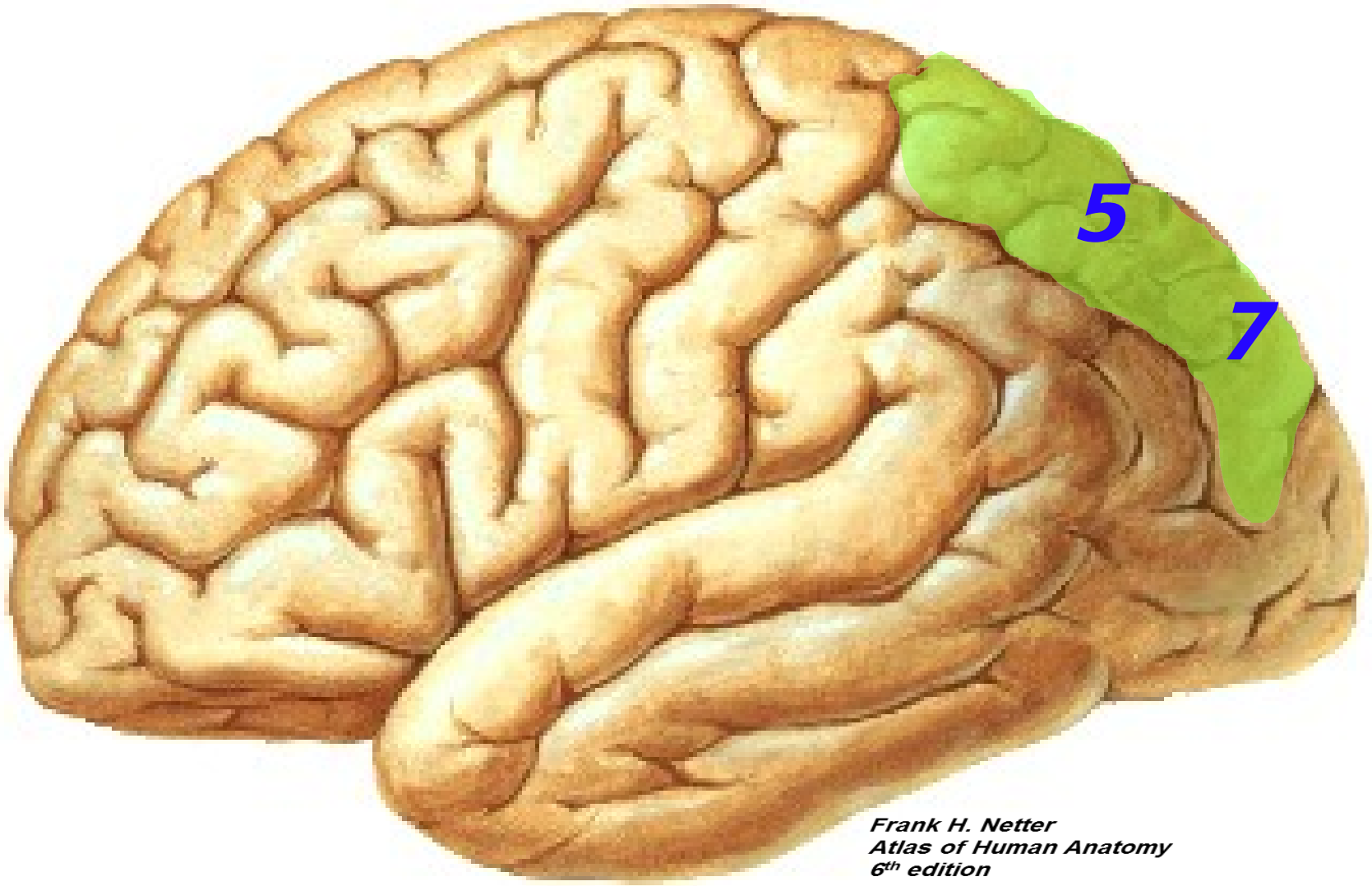
5
7
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Function:

- Integrates sensation received from S1 & stor them as long term memories of past expe
- Contains Stereogn center

Lesion:

Astereognosis

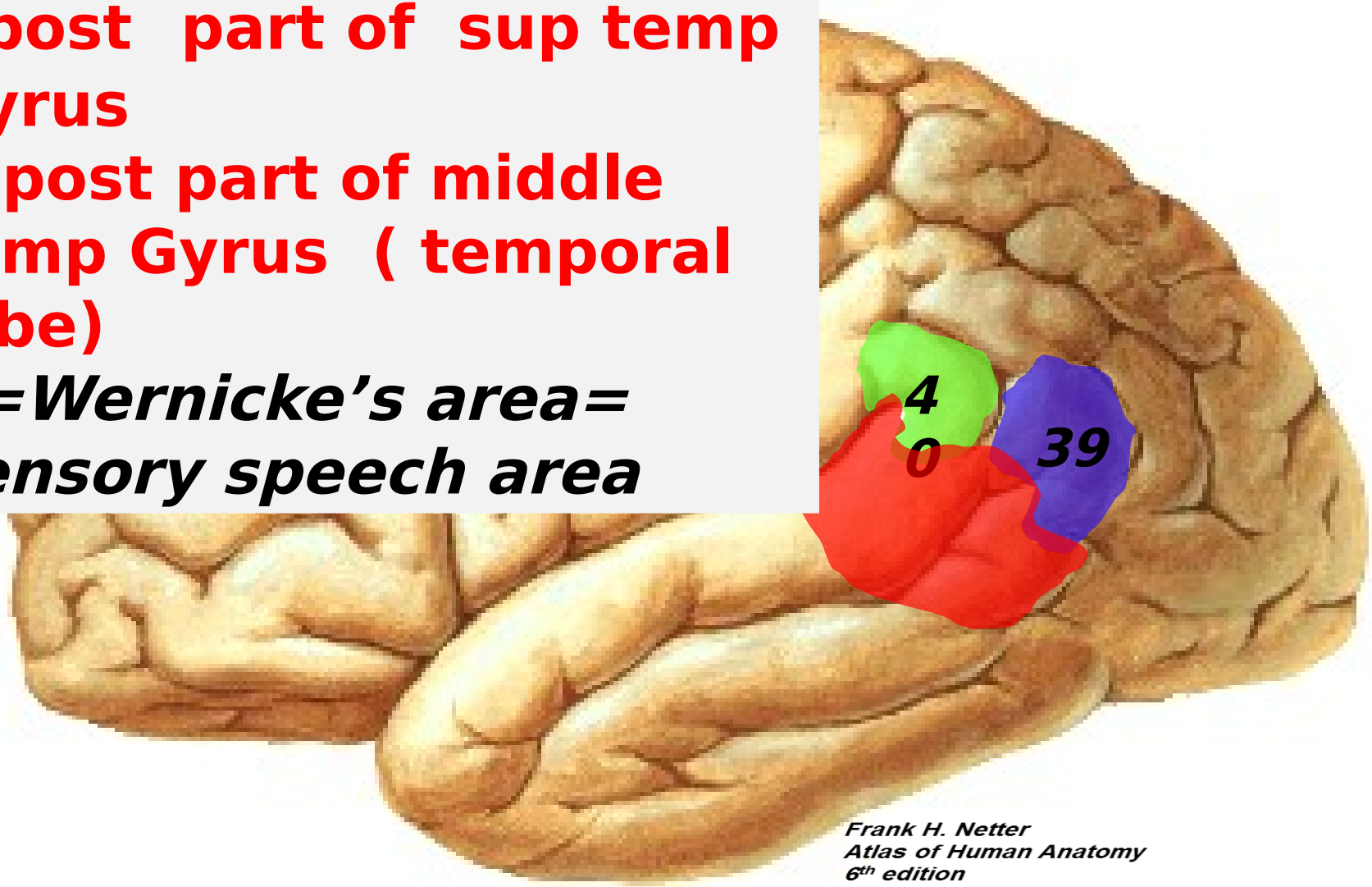
(inability to recogni familiar objects by touch)

A 40 + A39 (inf parietal lobule)

+post part of sup temp Gyrus

+ post part of middle temp Gyrus (temporal lobe)

=Wernicke's area= sensory speech area



Wernicke's area is present only in the dominant

Function

Wernicke's area

ensory speech area}

Responsible for

nderstanding speech

(heard or seen)

Lesion

Sensory

(receptive)

Aphasia patient ca

not understand

spoken or written wo

Important Note :

Speech center 3 re

1) Motor (anterior) speech center {Broca's area A44,45 }

2) Sensory(posterior) speech center {Wernicke's area A39,40 }

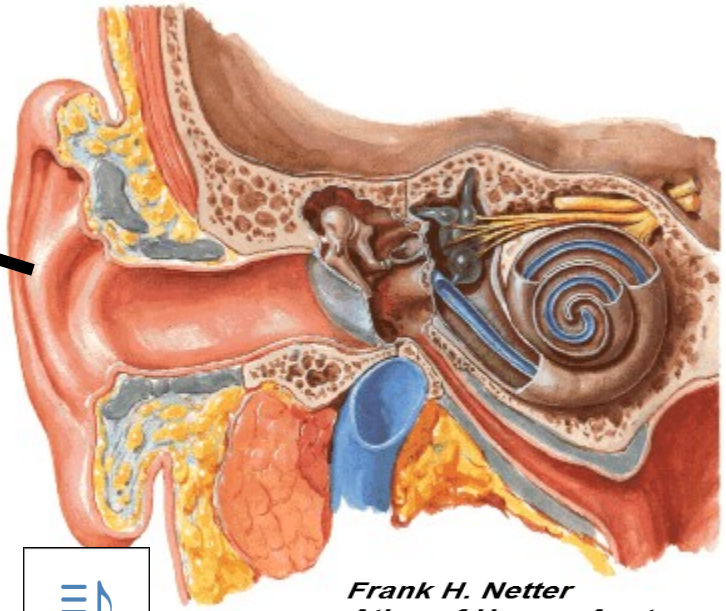
3) Third (superior) speech

Wernicke's area

Broca's area

Area 4

Muscles of the tongue& larynx



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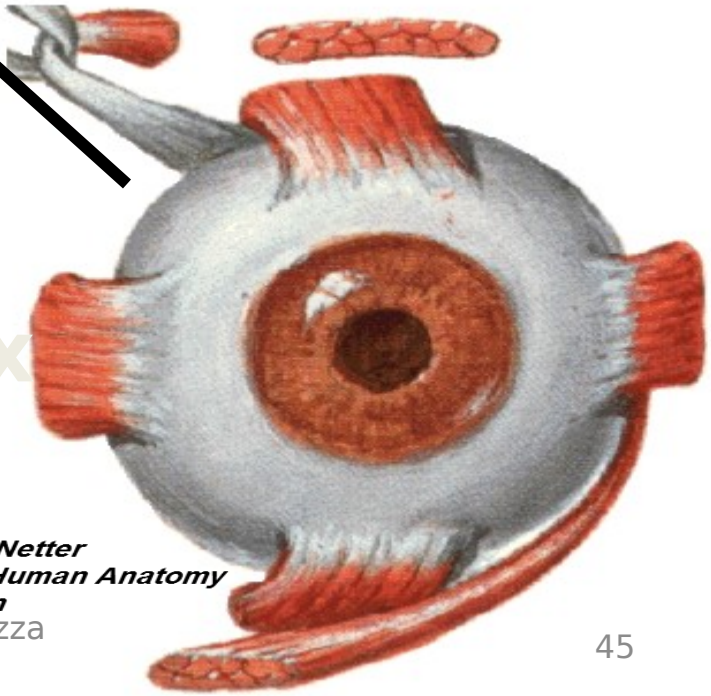

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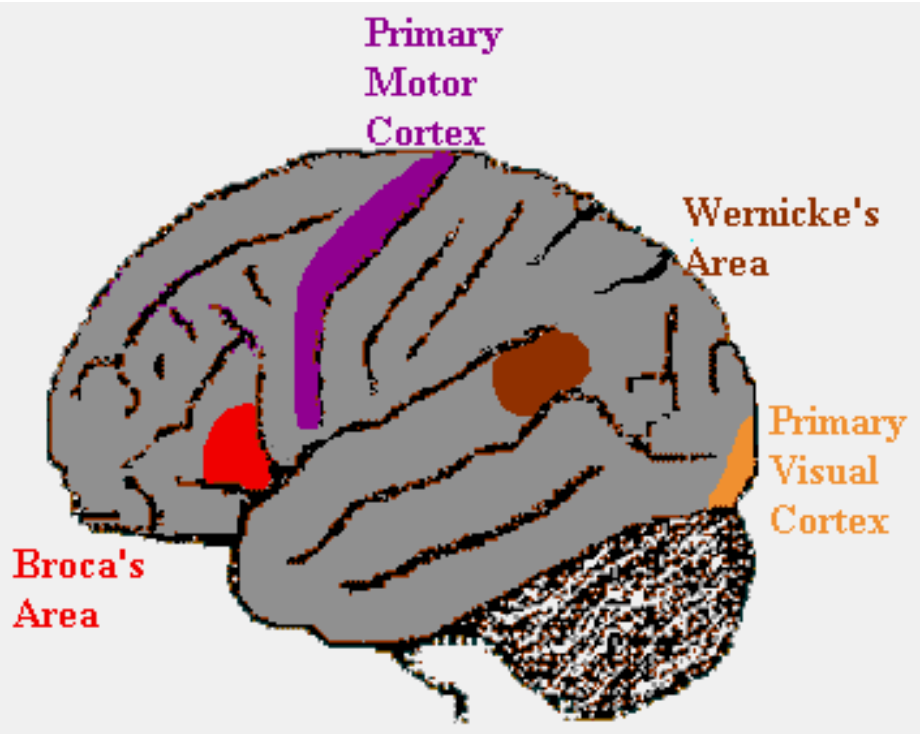
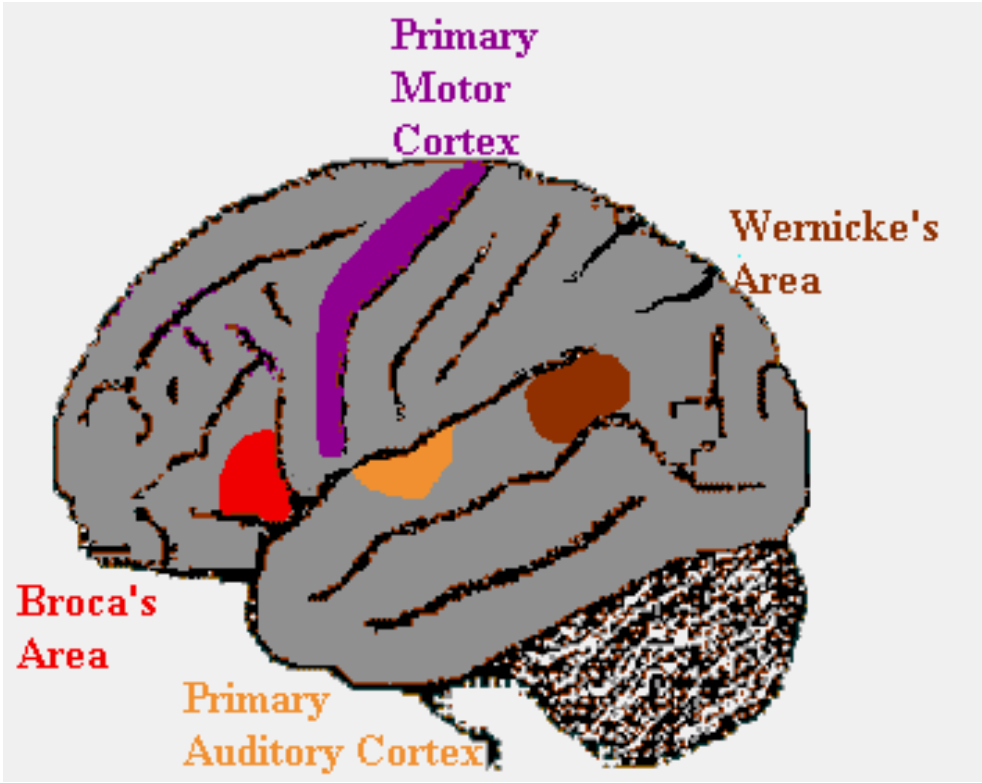
peaking the seen word

Speaking the heard word

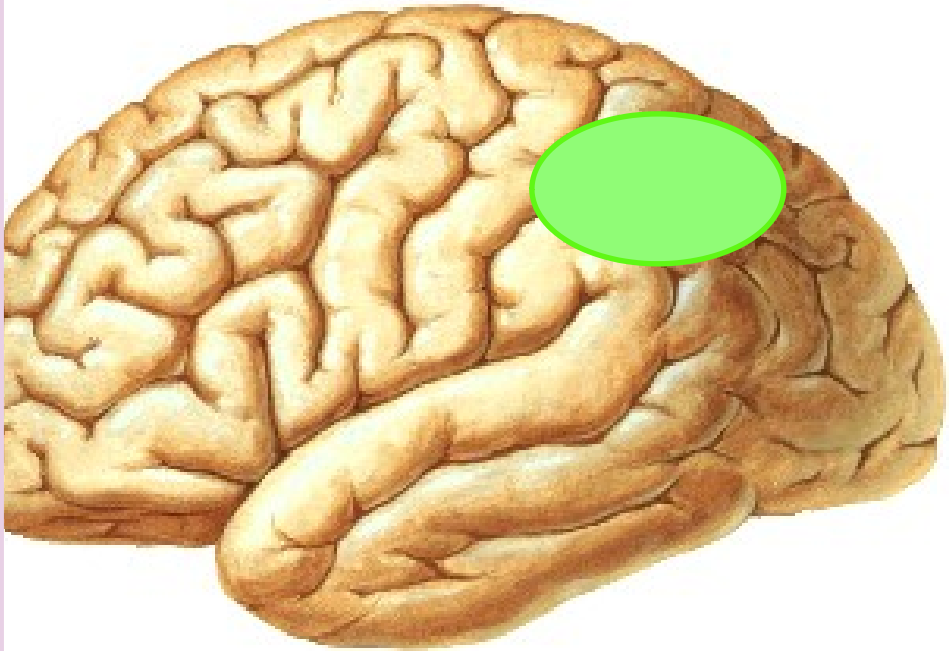




https://
www.google.com.eg/search?sa=G&hl=en-EG&q=kids+coloring+book+brain

Parietal lobe recognizes orientation of contralateral half of body (awareness of body parts)

Lesion: sensory neglect (contralateral hemineglect) patient fails to recognize



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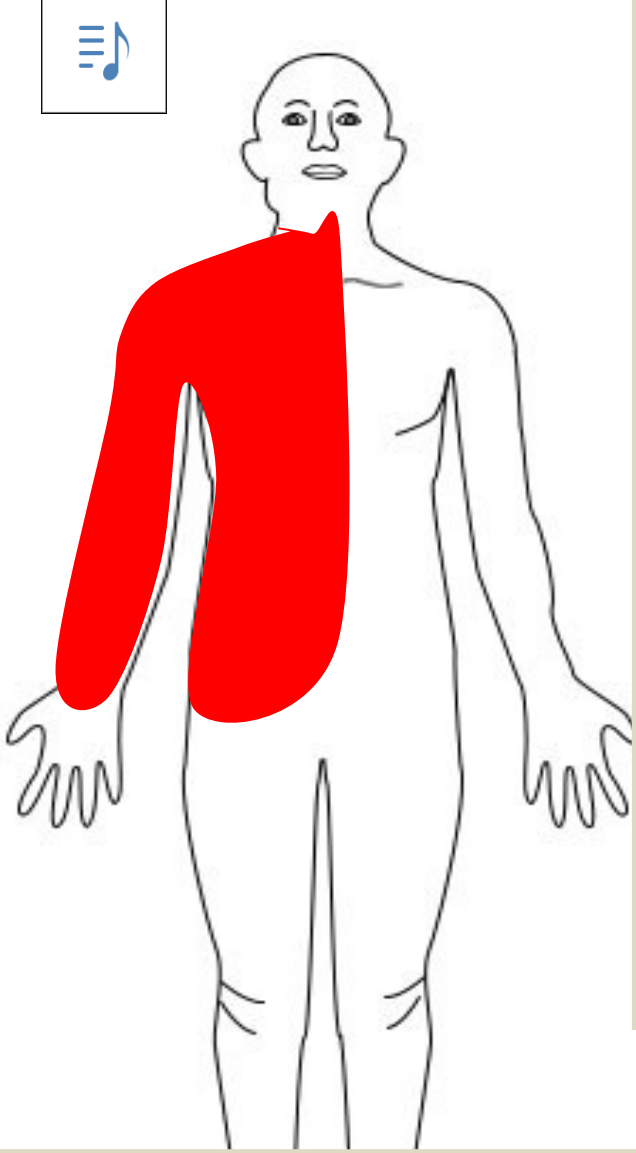


He dressed right sleeve of jacket & neglected to dress left upper limb

He shaved right side of beard & neglected left side

Contralateral hemineglect

Usually lesion is manifest if right hemisphere (non dominant) is affected

Following a vascular stroke affecting the parietal lobe of the right cerebral hemisphere, a right handed patient is expected to complain fro of the following symptoms?

A. Motor aphasia

B. Inability to move his left arm

C. Inability to move his left foot

D. Inability to recognize opposite side of body as its own.

E. Changes in behavior and personality

MCQ to test Functional areas and lesions of Parietal lobe

Temporal lobe

Primary Auditory Area A 41, 42

Secondary Auditory Area A 22

Facial recognition area

Part of :
-Wernicke's Area
-Vestibular area
-Olfactory areas

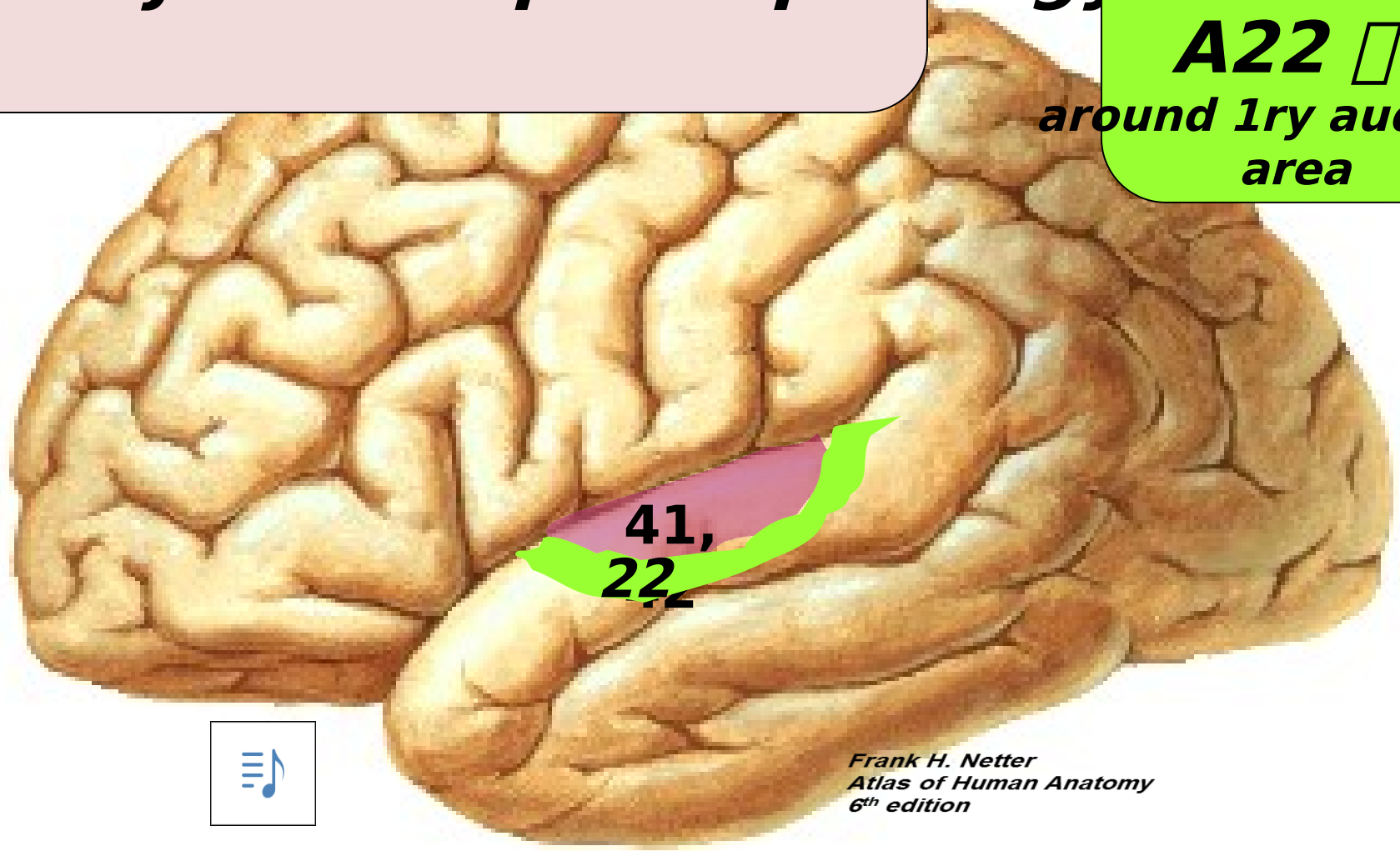
Primary Auditory Area:

Site inf. lip of lateral sulcu

& adjacent sup. temporal gy

**Secondary Auditory Area A22 **

around 1ry auditor area



Primary Auditory Area(A41,42)

Secondary Auditory Area (A22)

unction : perceptior

hearing from both ea

Lesion :

impaired hearing

not loss because

ochlea is bilaterally

represented

Function :

understands auditory

stimuli by associating

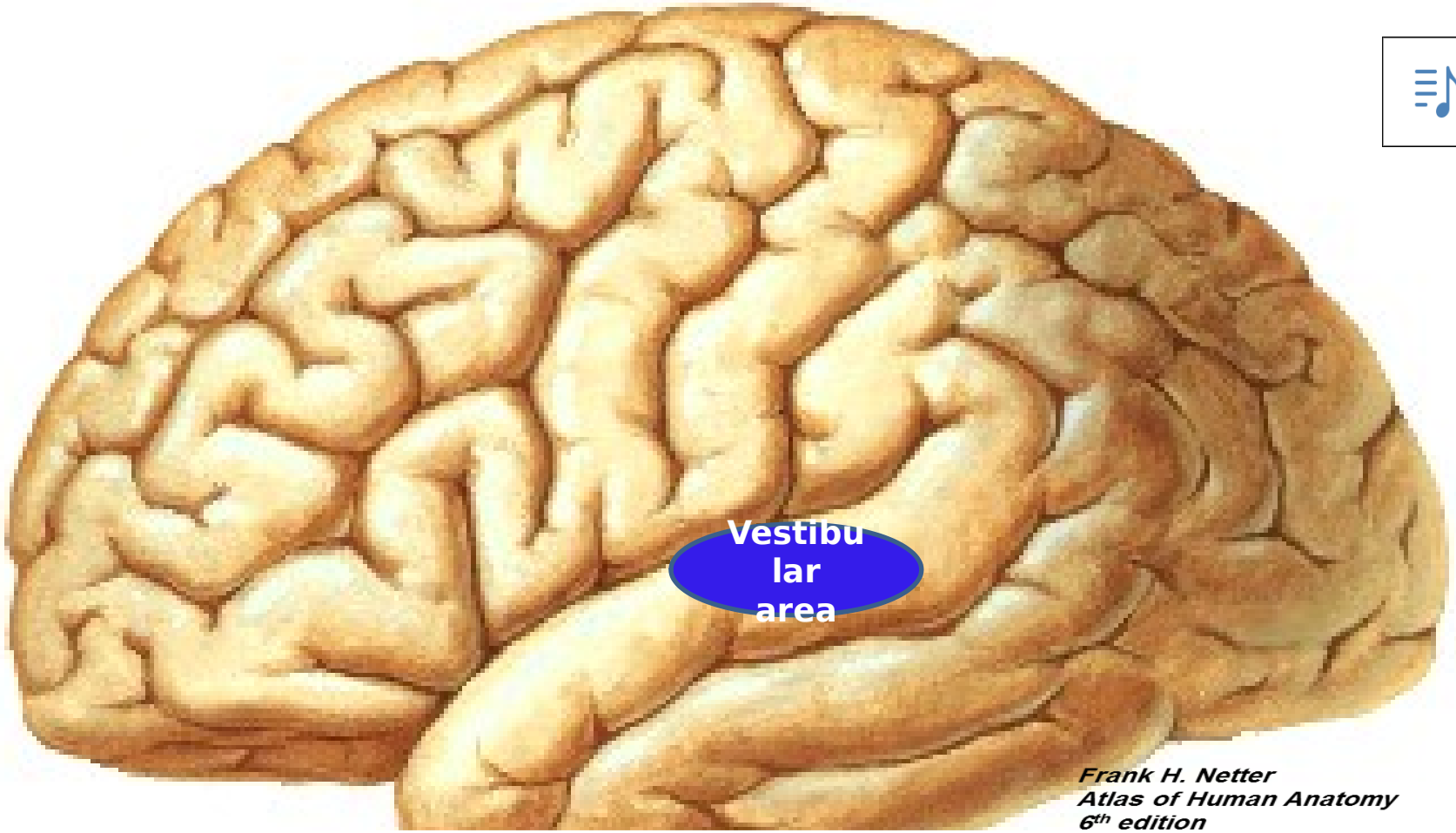
them with past experien

Lesion :

auditory verbal agnosi

(inability to understand sou

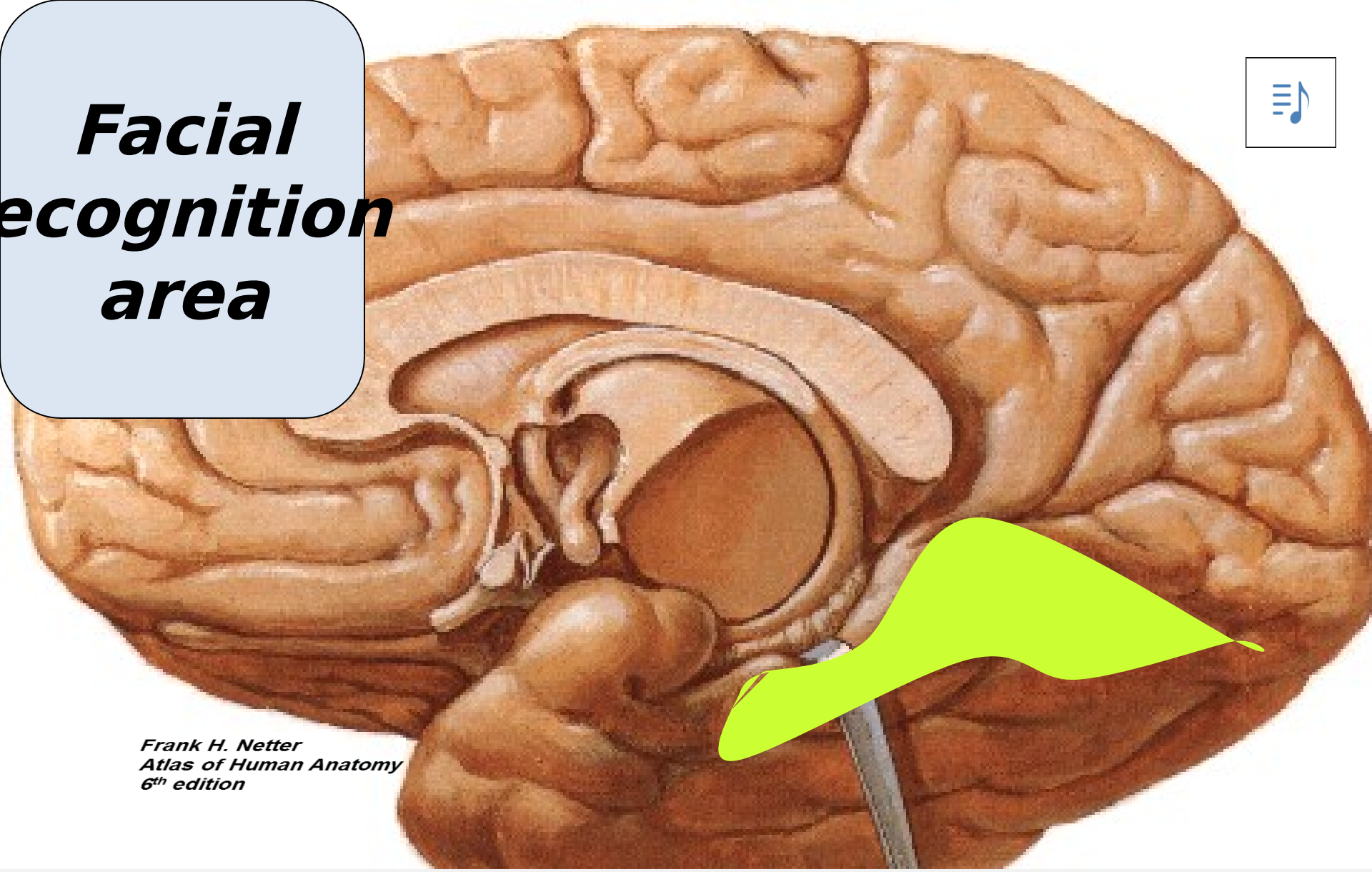
estibular area : close to auditory area



ves information about head position & movem

vestibular nuclei

Facial recognition area

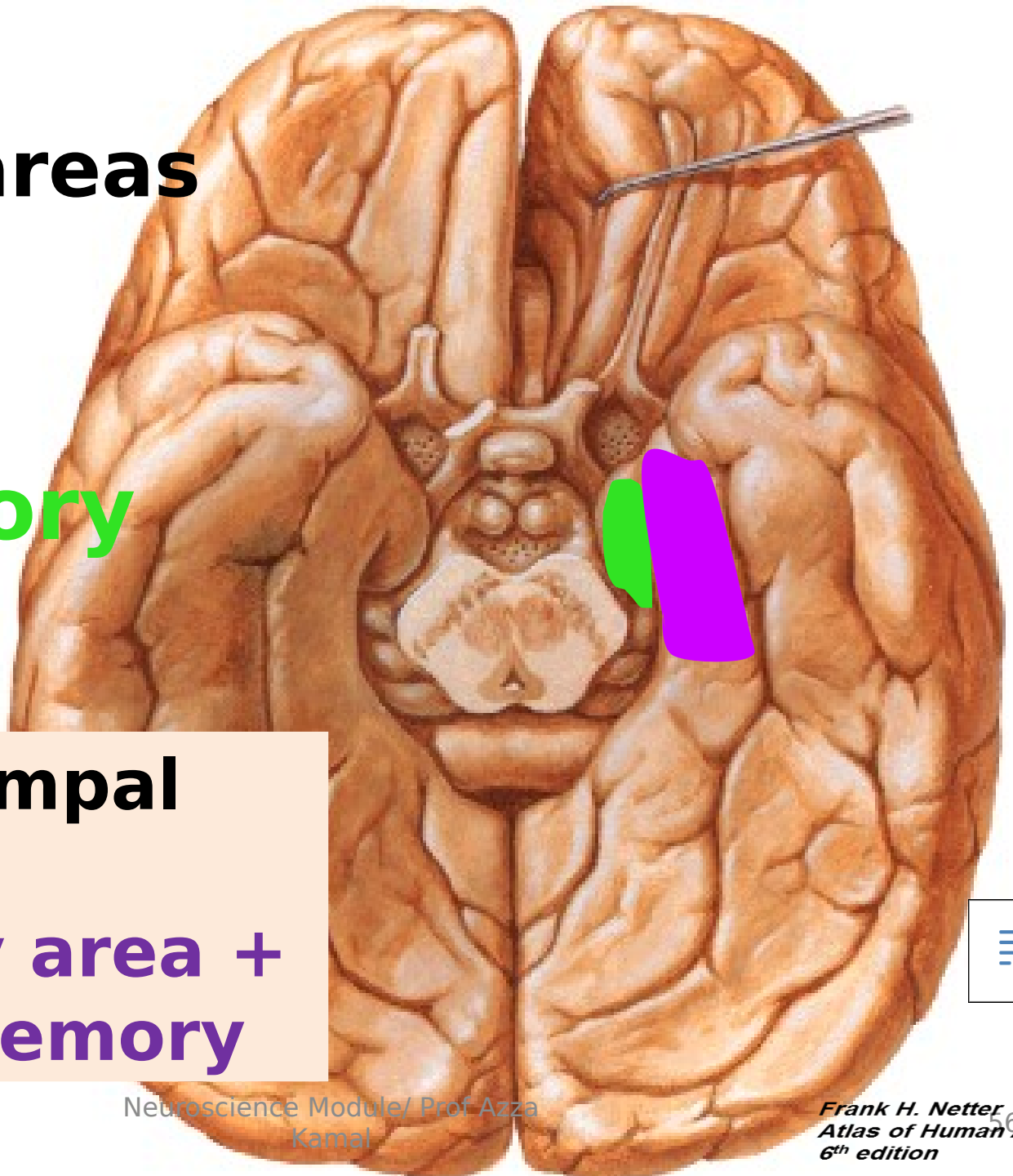


nf. surface of temporal & occipital l

Olfactory areas

Uncus:
Lry olfactory area

Parahippocampal Gyrus :
ry olfactory area + enter for memory



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A patient complains of inability to understand sounds. This is known as which of the following?

A. Sensory aphasia

B. Verbal agnosia

C. Prospagnosia

D. Impaired hearing

E. Anosmia

MCQ to test Functional areas and lesions of Temporal lobe

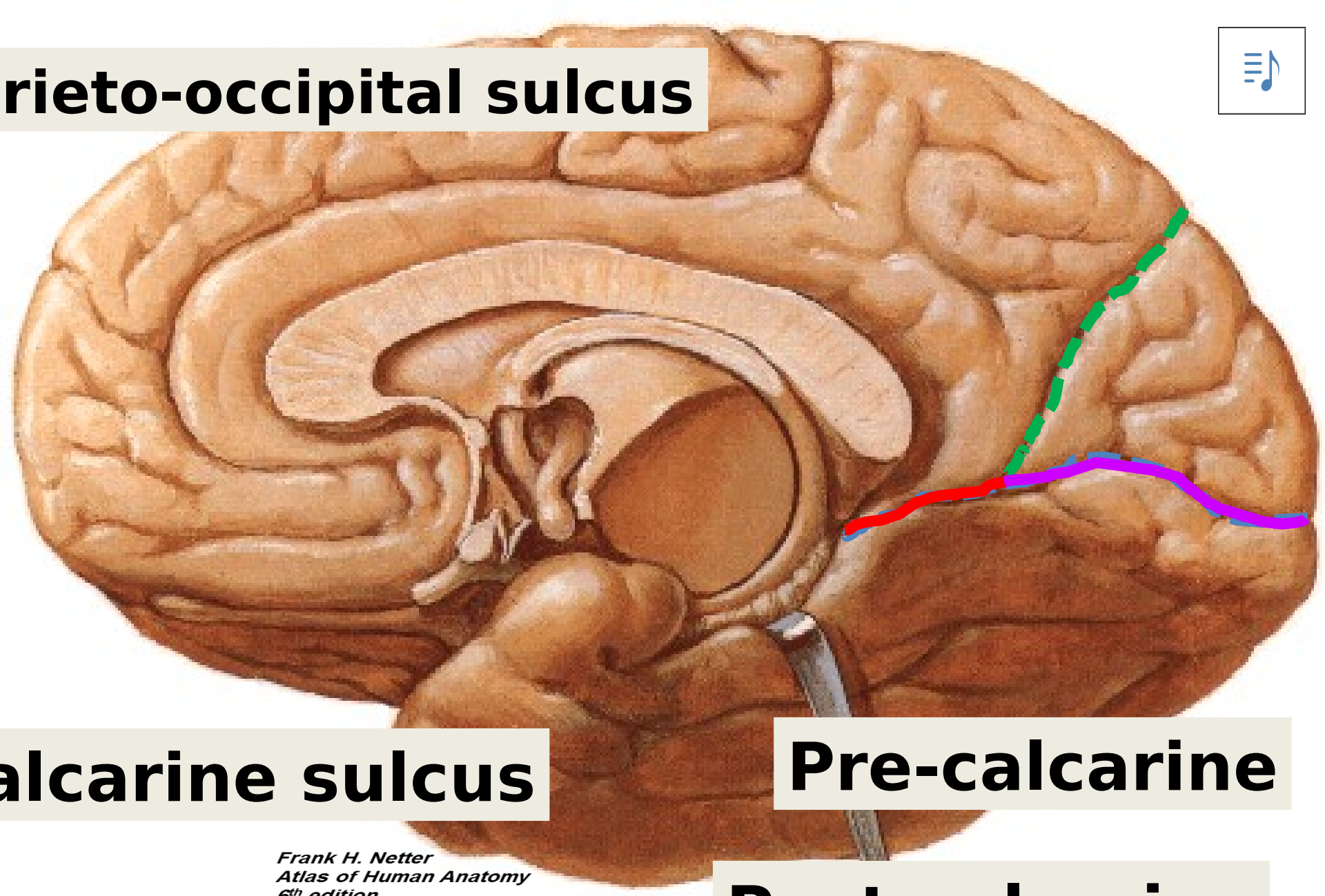
The occipital lobe

Primary visual Area A17

Visual association Areas A18,19

Part of Facial recognition area

Occipital Eye field


rieto-occipital sulcus
alcarine sulcus
Pre-calcarine
Post-calcarine
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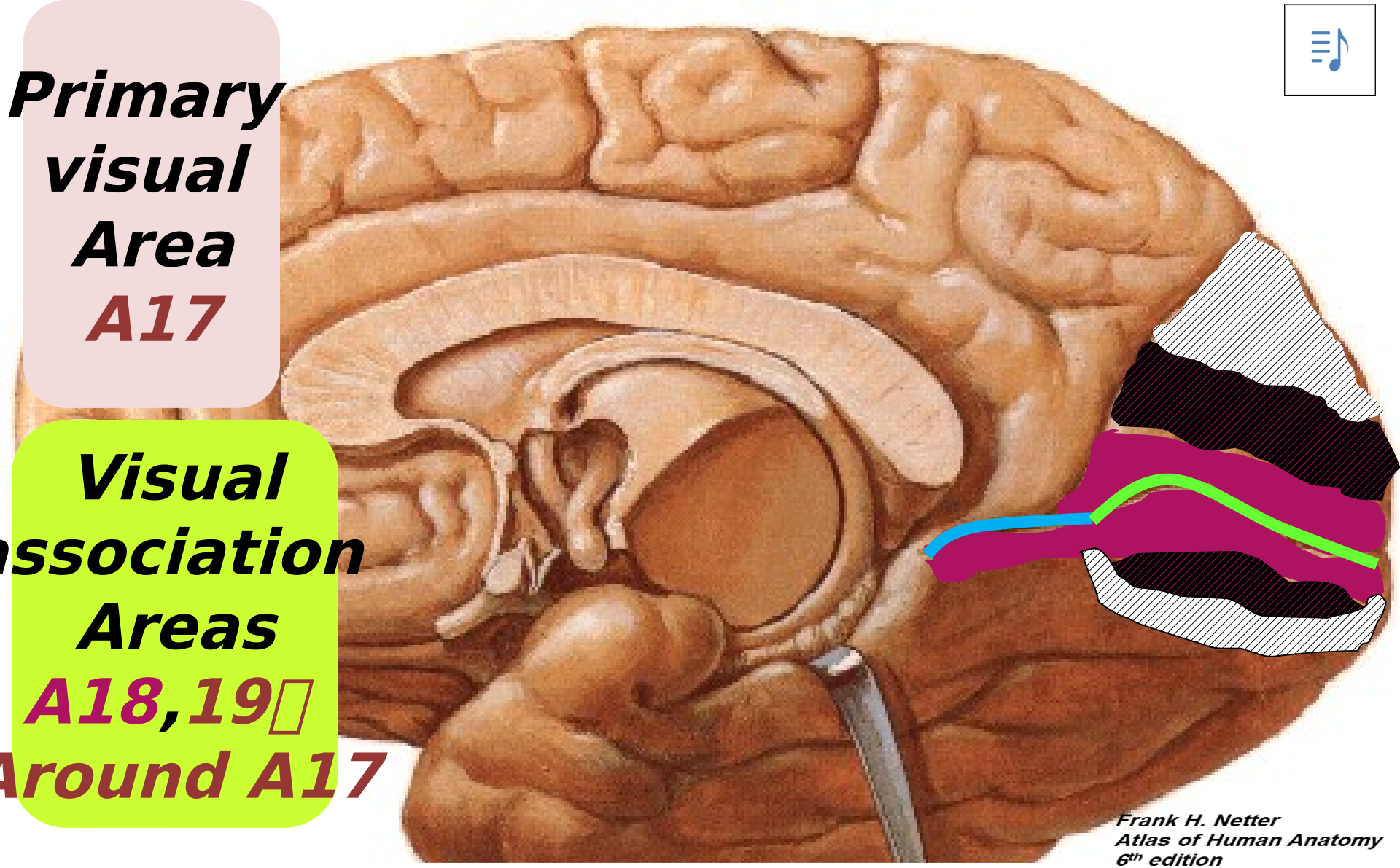
Primary visual Area A17

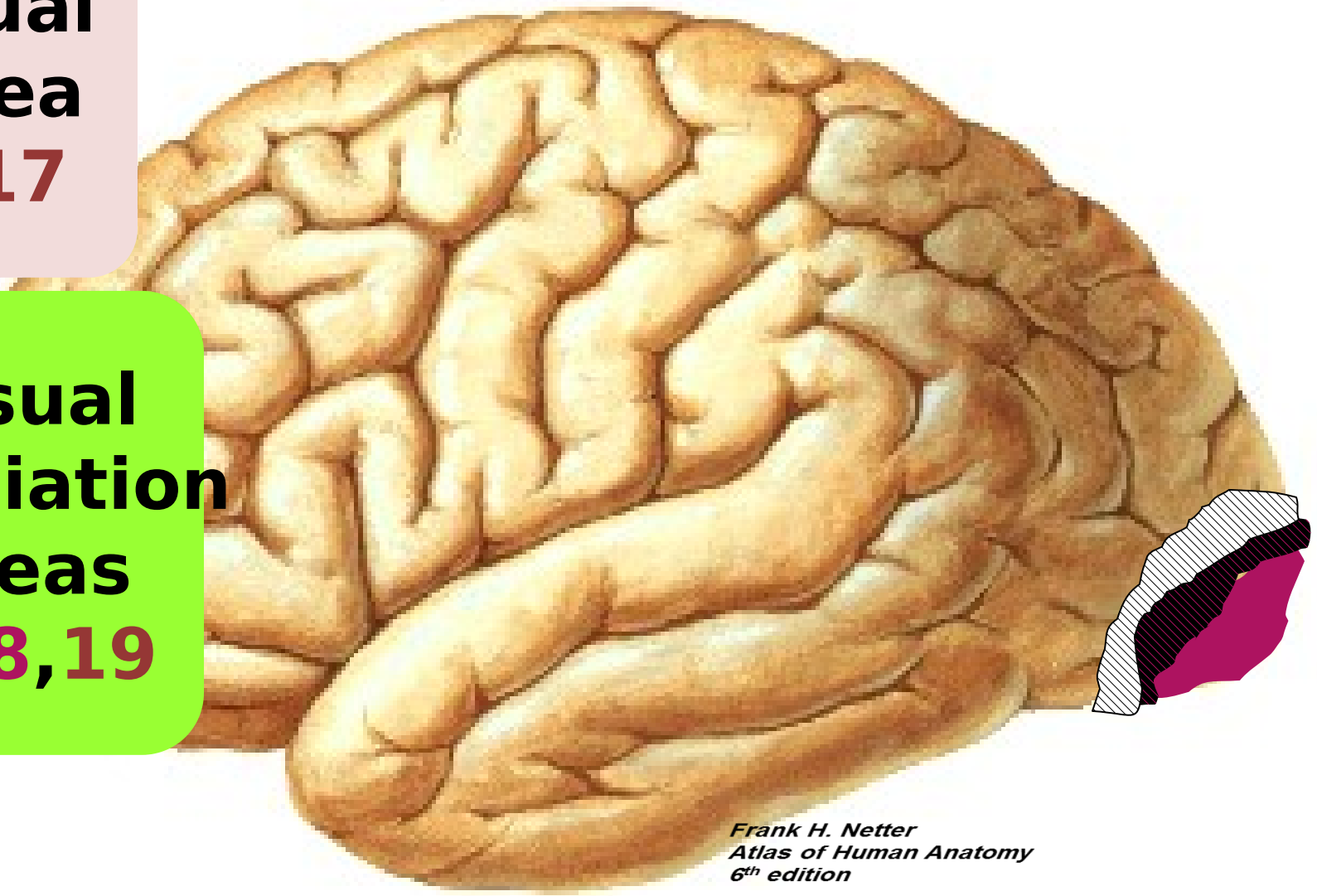
Visual association Areas A18,19 Around A17



Area 17 below precalcarine sulcus+ on both sides of postcalcarine sulcus+ extends on lat. surface till lunate sulcus

Primary visual Area A17

Visual association Areas A18,19

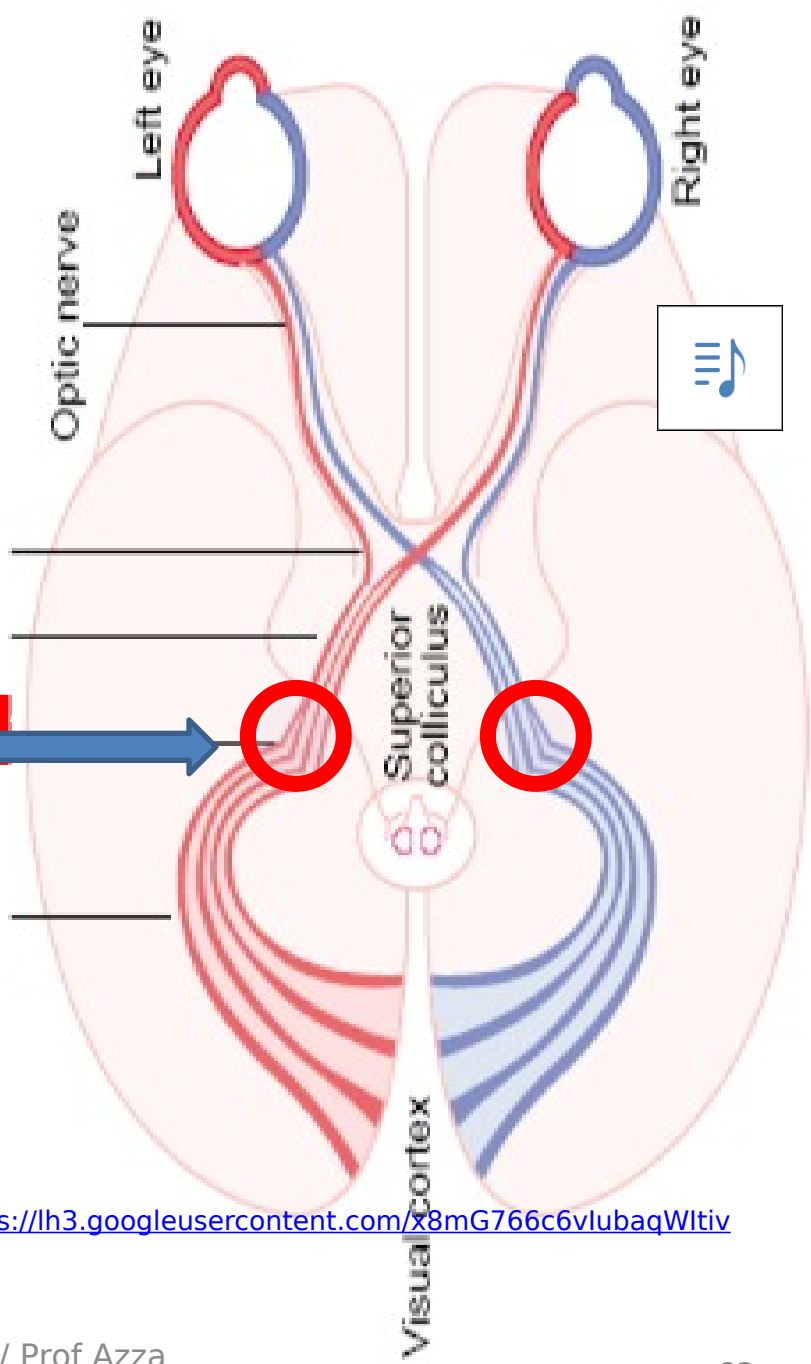


Primary visual Area(A17)

unction : perception of vision

ceives stimuli from LGB (lat.geniculate body)

esion : Homonymous Hemianopia loss of opposite field of vision)



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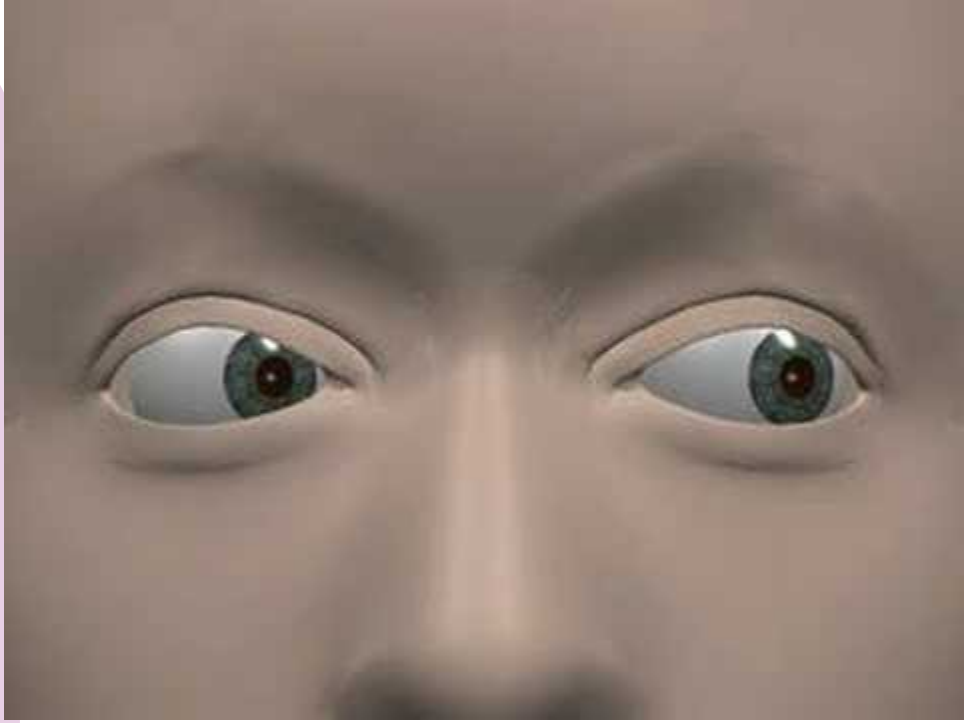
Visual Association Areas(A18,19)

Function : stores past visual experience to identify objects & help discriminate colors

Lesion visual agnosia (patient can see BUT can not identify what he sees)

Occipital Eye fi

Site : in A17 &



Responsible for
Involuntary (reflex)
Conjugate eye movement

https://
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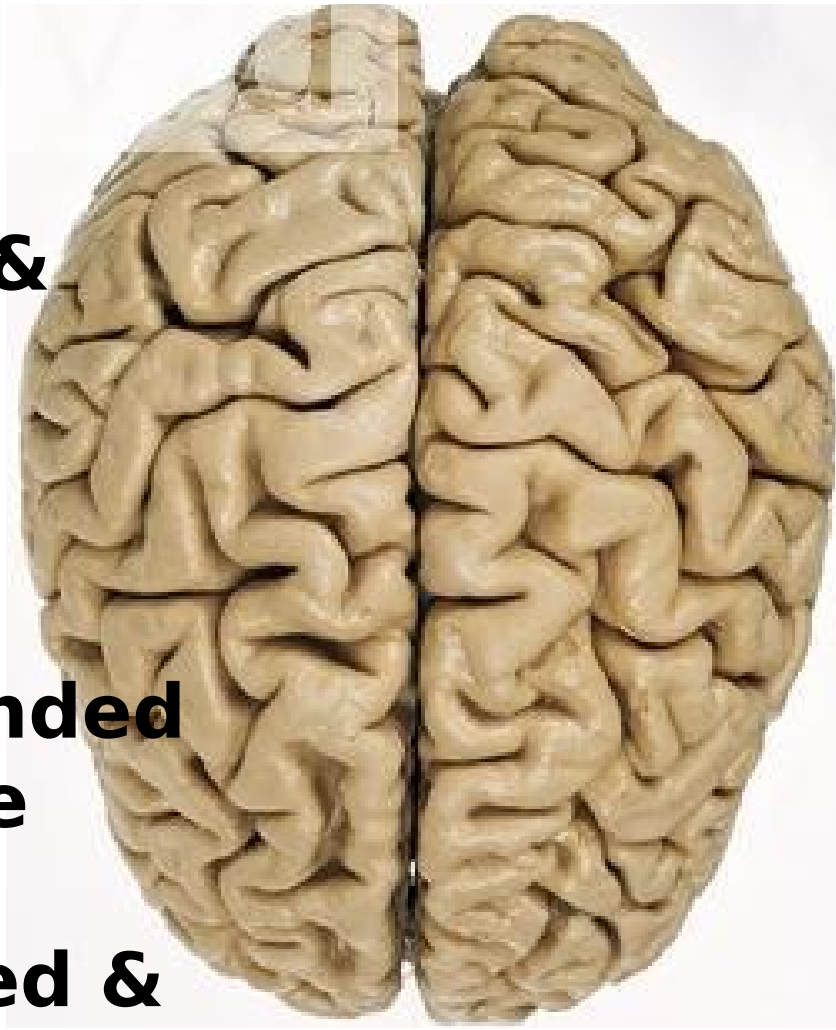
Cerebral Asymmetry

ht & left hemispheres are
identical as regards sulci &
.
eech areas are present in
hemisphere only
minant Hemisphere)
% of people are right -handed
those ,the left hemisphere
he Dominant hemisphere.
% of people are left-handed &
are mixed -handed and in both
ight or left hemisphere may be dominant



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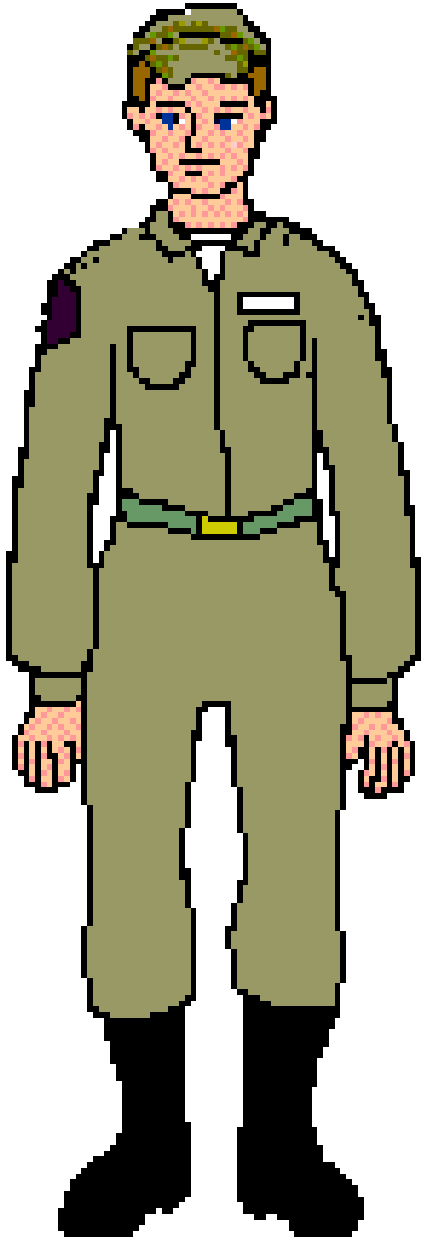
Which of the following functional areas of the cerebral hemispheres lies below the pre-calcarine sulcus, on both sides of post-calcarine sulcus and extends on the lateral s l the lunate sulcus ?

A. Primary visual area
B. Visual association area
C. Primary auditory area
D. Olfactory area
E. Facial recognition area

MCQ to test Functional areas and lesions of Occipital lobe.

Thank You



Reference:

Clinical Neuroanatomy, Richard Snell, 7th edition

Functional areas : Pages 288-295